Ballantine

INSTRUCTION MANUAL

MODEL 3036A/B DIGITAL MULTIMETER

Serial No. Prefix 020-

Ballantine Laboratories, Inc. • P.O. Box 97 • Boonton, New Jersey 07005 U.S.A.
Telephone: 201-335-0900 • TWX: 710-987-8380

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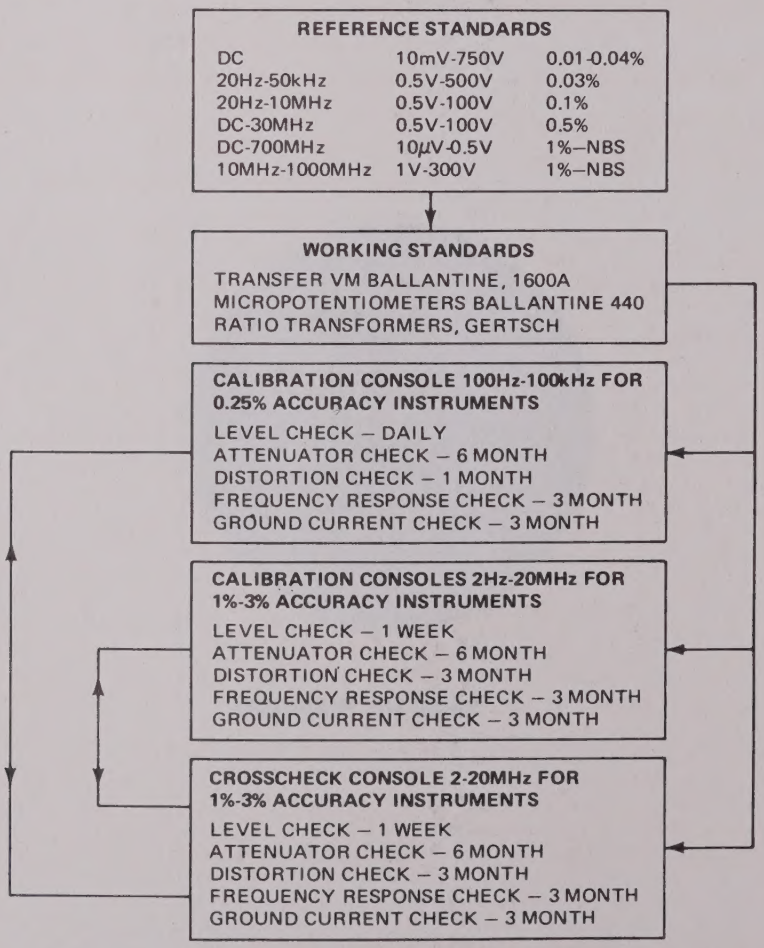
WARRANTY

This Ballantine Laboratories, Inc. product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except for batteries, electron tubes, vacuum thermocouples, and certain other components, if any, listed in this manual. Ballantine Laboratories, Inc. will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Ballantine Laboratories, Inc. prepaid, and provided the proper preventive maintenance and calibration procedures as listed in this manual have been followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BALLANTINE LABORATORIES, INC. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

CERTIFICATION

Ballantine Laboratories, Inc. certifies that this equipment meets all applicable Ballantine specifications at time of shipment from the factory as determined by thorough testing and inspection. Ballantine further certifies that its measurements are traceable to the United States National Bureau of Standards. All instruments used in calibrating Ballantine products are standardized by systematic reference to NBS-traceable standards as described in the validation procedures shown below.


REFERENCE STANDARDS
DC 10mV-750V 0.01-0.04%
20Hz-50kHz 0.5V-500V 0.03%
20Hz-10MHz 0.5V-100V 0.1%
DC-30MHz 0.5V-100V 0.5%
DC-700MHz 10μV-0.5V 1%–NBS
10MHz-1000MHz 1V-300V 1%–NBS
WORKING STANDARDS
TRANSFER VM BALLANTINE, 1600A
MICROPOTENTIOMETERS BALLANTINE 440
RATIO TRANSFORMERS, GERTSCH
CALIBRATION CONSOLE 100Hz-100kHz FOR 0.25% ACCURACY INSTRUMENTS
LEVEL CHECK – DAILY
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 1 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH
CALIBRATION CONSOLES 2Hz-20MHz FOR 1%-3% ACCURACY INSTRUMENTS
LEVEL CHECK – 1 WEEK
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 3 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH
CROSSCHECK CONSOLE 2-20MHz FOR 1%-3% ACCURACY INSTRUMENTS
LEVEL CHECK – 1 WEEK
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 3 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH

Ballantine's Quality Assurance program satisfied the requirements of MIL-I-45208

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Figure 1–1. Model 3036A/B Digital Multimeter

SECTION 1

GENERAL INFORMATION

1–1. INTRODUCTION

1–2. This manual provides operation and maintenance information for the Ballantine Model 3036A/B Digital Multimeter. Section 1 is a general description of Model 3036A/B. Sections 2 and 3 contain installation and operation instructions. The theory of operation is described in Section 4. Section 5 outlines maintenance and troubleshooting procedures. Section 6 has tables of replaceable parts and recommended spare parts.

1–3. DESCRIPTION

1–4. The Ballantine Model 3036A Multimeter is a 4-1/2 digit, five function instrument which measures ac and dc voltages, ac and dc currents, and ohms. The Model 3036B is similar to the 3036A but features tighter accuracy specifications.

The instrument features a bright orange 11 mm (0.43") LED display of 4½ digits, permitting plus or minus 19999 counts. The decimal point is automatically positioned with range selection. Zero drift is prevented by an autozeroing circuit.

1–5. The Model 3036A/B is well protected against overloads. 1200V on any D.C. voltage range, 750V rms on any ac voltage range or a 285 Volt power line on any ohms ranges will not damage the instrument. Overload recovery is fast, enabling measurements to continue with no time loss. Protection is provided by means of electronic limiters except for the current ranges where the input is circuit breaker protected. The circuit breaker is accessible on the front panel.

1–6. The Model 3036A/B features built-in battery condition and display tests. Pushing simultaneously DCV and DCA will light all segments on the display for a quick check of all seven segments. Pushing DCV and 20MΩ will provide the internal battery check. Battery operation is provided by Option 05.

1–7. The Model 3036A may be operated either from a 115 or 230 vac power adapter, 9 to 14 vdc or internal rechargeable batteries. The built-in charger provides full charge with Power switch OFF and the instrument connected to dc power or ac power adapter. Trickle charge occurs with the power switch ON. The unit may be operated from dc or ac power adapters with or without batteries installed (NiCad batteries option – 05).

1–8. The instrument is housed in a rugged and attractive shielded plastic case, and is small and light enough to be easily carried. Quality components and reliable design techniques are used throughout to assure high reliability and low power consumption. A single circuit board is used for reliability and rapid maintenance.

1–9. SPECIFICATIONS

1–10. Specifications for the 3036A are listed in Table 1–1 and in Table 1–2 for the 3036B. These specifications are the performance standards and/or limits to which the instruments may be tested.

1–11. ACCESSORIES

1–12. The accessories available for use with Model 3036A are listed in Table 1–3.

1–13. Manual Applicability.

1–14. All references in this manual will be to the 3036A digital multimeter. All options will be detailed in Section 7. The 3036B is similar in all functional respects to the 3036A and its accuracies are detailed in Table 1–2 and in the Maintenance Procedures of Section 5 and parts lists and schematics of Section 6.

1–15. INSTRUMENT AND MANUAL IDENTIFICATION

1–16. These Ballantine instruments are identified by a two section serial number. The first three digits section of this number identify the configuration code. This code number appears on the front page of this manual and must coincide with the first three digits of the serial number of your instrument. Addendum sheets supplied with the manual will define technical corrections or differences between your instrument and the unit described in this manual. If applicable, backdating information is located at the end of this manual. This backdating information pertains to instruments with serial number prefixes listed on the title page of this manual.

TABLE 1-1. 3036A SPECIFICATION
(For 1 year without recalibration)

DC VOLTAGE

Ranges: ±200 mV, ±2V, ±200V, ±1200V

Resolution: ±10 μV on 200 mV range

Accuracy: (1 year, 15°C to 35°C): ±(0.05% of reading +1 LSD)

Input Impedance: 10 MΩ all ranges

Normal Mode Rejection: >60 dB at DC, 50 Hz and 60 Hz

Common Mode Rejection: >120 dB at DC, 50 Hz and 60 Hz (with 1KΩ unbalance, common driven)

Temperature Coefficient:
(All ranges. 0-15°C and 35-50°C) ±(0.005% of reading)/°C

Zero Stability: Auto zeroed on all ranges

Polarity: Automatic bipolar + or − display

Overload: ±1200V dc or 1700V peak ac applied continuously.

Response Time: 1 second max. to rated accuracy

DC CURRENT

Ranges: ±200 μA, ±2 mA, ±20 mA, ±200 mA, and ±2000 mA.

Resolution: ±10 nA on 200 μA range

Accuracy:
(1 year, 15°C to 35°C) ±0.2% of reading + 3 LSD)
All ranges

Temperature Coefficient:
(All ranges. 0-15°C and 35-50°C) ±(0.01% of reading)/°C.

Overload: Protected above 2A on all ranges by resettable circuit breaker. Limited to 15A peak.

AC VOLTAGE (True RMS Responding)

Ranges: 200 mV, 2V, 20V, 200V, 750V

Accuracy: 200V, 30 Hz − 45 Hz ±(1% of Reading +5 LSD)
45 − 20 kHz ±(0.6% of Reading +5 LSD)
1 year 15°C to 35°C (all ranges above 200 counts)
750, as above to 1 kHz,1 kHz − 10 kHz ±(1% of Reading +5 LSD)

Resolution: 10 μV on 200 mV range

Temperature Coefficient:
(All ranges 0-15°C and 35-50°C) ±(0.005% Reading)/°C

Crest Factor: 5 at full range (19.999 counts) 10 at 1/2 range (10,000 counts) and below.

Input Impedance: 1 MΩ shunted by <100 pF all ranges

Response Time: 3 seconds max. to rated accuracy.

Overload: 750V rms or 1100V peak ac applied continuously. Not to exceed 1 x 10^7 VHz product.

AC CURRENT (True RMS Responding)

Ranges: 200 μA, 2 mA, 20 mA, 200 mA, and 2000 mA

Resolution: 10 nA on 200 mA range.

Crest Factor: 5 at full range (19.999 counts) 10 at 1/2 range (10,000 counts) and below.

Accuracy:
(1 year, 15°C to 35°C): 30 Hz − 45 Hz ±(1% of reading +5 LSD). (All ranges above 200 counts)
45 Hz − 10 kHz ±(0.7% of reading +5 LSD)

Temperature Coefficient:
(All ranges. 0-15°C and 35-50°C) ±(0.03% of reading)/°C

Response Time: 3 seconds max. to rated accuracy.

Overload: Protected above 2A on all ranges by circuit breaker Reset on front panel. Limited to 15A peak.

RESISTANCE

Ranges: 200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ and 20 MΩ.

Resolutions: 10 Milliohms on 200Ω range

Accuracy:
(1 year, 15°C to 35°C)
200Ω to 2000 kΩ: ±(0.1% of reading +3 LSD)
20 MΩ: ±(0.2% of reading +3 LSD)

Zero Adjust: Front panel shaft screwdriver adjustment for lead resistance compensation. Active only on lowest (200Ω) range. Autozero on all other ranges.

Temperature Coefficient:
(All ranges. 0-15°C and 35-50°C) 0.01% of reading /°C.

Max. Open Circuit Voltage: 7 volts

Overload Protection: ±285V dc or ac peak applied continuously to any range.

Response Time:
200Ω thru 2000 kΩ: 1 sec. max. to rated accuracy
20 MΩ: 4 sec. max. to rated accuracy

Measuring Conditions on Resistor Under Test:

Range	Current	Voltage
200Ω	1 mA	<200 mV (LO)
2 KΩ	1 mA	<2 V
20 KΩ	10μA	<200 mV (LO)
200 KΩ	10 μA	<2 V
2000 KΩ	1 μA	<2 V
20 MΩ	100 nA	<2 V

TABLE 1-1. 3036A SPECIFICATIONS
(For 1 year without recalibration) - Continued

GENERAL

Display:
Seven segment LED .43" character height.
Automatic decimal point and polarity indicators.

Overrange Indication: Flashing display.

Battery Test: Battery condition will be displayed when DCV and 20 MΩ are pushed simultaneously.

Display Test: Four digits, seven segment test when pushing both DCV and DC mA.

Maximum Common Mode Voltage: 1200 ±(dc + peak ac) with battery operation.
500V ±(dc + peak ac) with ac accessory.

Operating Temperature: −10°C to 55°C.

Humidity Range:
0 to 90% R.H.
0 to 85% R.H. above 45°C
Usable to 95% R.H.

Power Requirements: DC, +9 to +14 volts; 400 mA.
AC Power (optional) with external power adapters:
Option 30: 103 to 127V rms, 60 to 400 Hz.
Option 31: 210 to 248V rms, 50 to 400 Hz.
Option 05: Internal rechargeable battery operation.
4 NiCad rechargeable "C" cell batteries. 16 hour recharge; 5 hours typical operation.

Supplied Accessories: 1 Power Cable, 6 feet (for external DC) P/N 85-10072-1A
1 Instruction Manual
1 Probe Test Lead, 4 feet, (red) P/N 85100620
1 Probe Test Lead, 4 feet, (black)

TABLE 1-2. 3036B SPECIFICATIONS
(For 1 year without recalibration)

DC VOLTAGE

Ranges: ±200mV, ±2V, ±200V, ±1200V.

Resolution: ±10 μV on 200 mV range

Accuracy: (1 year, 15°C to 35°C) ±(0.02% of reading ±1 LSD)

Input Impedance: 10 MΩ all ranges

Normal Mode Rejection: >60 dB at DC, 50 Hz and 60 Hz

Common Mode Rejection: >120 dB at DC, 50 Hz and 60 Hz (with 1KΩ unbalance, common driven)

Temperature Coefficient: ±(0.002% of reading) /°C (All ranges. 0-15°C and 35-50°C)

Zero Stability: Auto zeroed on all ranges

Polarity: Automatic bipolar + or − display

Overload: ± 1200V DC or 1700V peak AC applied continuously.

Response Time: 1 second max. to rated accuracy

DC CURRENT

Ranges: ±200μA, ±2 mA, ±20 mA, ±200 mA, and ±2000 mA.

Resolution: ±10 nA on 200 μA range

Accuracy: (1 year, 15°C to 35°C) ±(0.1% of reading +3 LSD). All ranges

Temperature Coefficient: ±(0.005% of reading /°C.) (All ranges. 0-15°C and 35-50°C)

Overload: Protected above 2A on all ranges by resettable circuit breaker. Limited to 15A peak.

AC VOLTAGE (True RMS Responding)

Ranges: 200 mV, 2V, 20V, 200V, 750V

Accuracy: 200V, 30 Hz − 45 Hz ±(1% of Reading +5 LSD)
45 Hz − 100 Hz ±(0.5% of Reading +5 LSD)
1 year 15°C to 35°C (all ranges above 200 counts)
100 Hz − 10 kHz ±(0.2% of Reading +5 LSD)
10 kHz − 20 kHz ±(0.5% of Reading +5 LSD)
750, as above to 1 kHz, 1 kHz − 10 kHz ±(1% of Reading +5 LSD)

Resolution: 10 μV on 200 mV range

Temperature Coefficient: ±(0.005% reading) /°C (All ranges 0-15°C and 35-50°C)

Crest Factor: 5 at full range (19.999 counts) 10 at 1/2 range (10,000 counts) and below.

Input Impedance: 1 MΩ shunted by <100 pF all ranges

Response Time: 3 seconds max. to rated accuracy.

Overload: 750V rms or 1100V peak AC applied continuously. Not to exceed 1 x 10^7 VHz product.

AC CURRENT (True RMS Responding)

Ranges: 200 μA, 2 mA, 20 mA, 200 mA, and 2000 mA.

Resolution: 10 nA on 200 mA range.

Crest Factor: 5 at full range (19.999 counts) 10 at 1/2 range (10,000 counts) and below.

TABLE 1-2. 3036B SPECIFICATIONS
(For 1 year without recalibration) - Continued

GENERAL.

Display:
Seven segment LED,43" character height.
Automatic decimal point and polarity indicators.

Overrange Indication: Flashing display.

Battery Test: Battery condition will be displayed when DCV and 20 MΩ are pushed simultaneously.

Display Test: Four digits, seven segment test when pushing both DCV and DCA.

Maximum Common Mode Voltage: 1200 ±(dc + peak ac) with ac accessory.

Operating Temperature: −10°C to 55°C

Humidity Range:
0 to 90% R.H.
0 to 85% R.H. above 45°C
Usable to 95% R.H.

Power Requirements: DC, +9 to +14 volts; 400 mA.
AC Power (optional) with external power adapters:
Option 30; 103 to 127V rms, 60 to 400 Hz.
Option 31: 210 to 248V rms, 50 to 400 Hz.
Option 05: Internal rechargeable battery operation.
4 NiCad rechargeable "C" cell batteries. 16 hour recharge; 5 hours typical operation.

Supplied Accessories: 1 Power Cable, 6 feet (for external DC) P/N 85-10072-1A
1 Instruction Manual
1 Probe Test Lead, 4 feet, (red) P/N 85100620A
1 Probe Test Lead, 4 feet, (black)

Accuracy (1 year, 15°C to 35°C): 30 Hz − 100 Hz ±(1% of reading +5 LSD).
All ranges above 200 counts) 100 Hz − 10 kHz ±(0.5% of reading +5 LSD)

Temperature Coefficient: ±(0.03% of reading) /°C

Response Time: 3 seconds max. to rated accuracy.

Overload: Protected above 2A on all ranges by circuit breaker Reset on front panel. Limited to 15A peak.

RESISTANCE:

Ranges: 200Ω, 2KΩ, 200 kΩ, 2000 kΩ and 20kΩ

Resolutions: 10 Milliohms on 200Ω range

Accuracy (1 year, 15°C to 35°C)
200Ω to 2000 kΩ: ±(0.05% of reading +3 LSD)
20 MΩ: ±(0.1% of reading +3 LSD)

Zero Adjust: Front panel shaft screwdriver adjustment for resistance compensation. Active only on lowest (200Ω) range. Autozero on all other ranges.

Temperature Coefficient: ±0.005% of reading /°C
(All ranges. 0-15°C and 35-50°C)

Max. Open Circuit Voltage: 7 volts

Overload Protection: ±285V DC or AC peak applied continuously to any range.

Response Time:
200Ω thru 2000 kΩ: 1 sec. max. to rated accuracy
20 MΩ: 4 sec. max. to rated accuracy

Measuring Conditions on Resistor Under Test:

Range	Current	Voltage
200 Ω	1 mA	<200 mV (LO)
2 KΩ	1 mA	<2 V
20 KΩ	10 μA	<200 mV (LO)
200 KΩ	10 μA	<2 V
2000 KΩ	1 μA	<2 V
20 MΩ	100 nA	<2 V

TABLE 1–3. ACCESSORIES

Model	Description
10800B	40 kV, HV DC Probe
1301B	10 kV, HV AC Probe
10850B	RF Probe, 100 kHz to 700 MHz
12628A	100:1 capacitive divider for 10850B (to 300 V)
10860A	Current Probe, AC, Clamp on to 600A
10801B	Test Lead Kit, 4 probes
10730A	Carrying Case, padded vinyl, 5" x 9" x 12"
10731A	Carrying Case, molded plastic
606	Shunt, AC/DC, 20 Amps (0.01Ω)
10751A	Front Panel Dust Cover
800-09	Rack Mount Kit, left or right (one instrument)
800-10	Rack Mount Kits, side-by-side (two instruments)
12616A	Adapter, Shielded, double banana to BNC female
12617A	Adapter, double banana to BNC female
12249D	Cable, BNC to BNC Shielded cable, 4 feet
12250D	Cable, BNC to alligator clips, 4 feet
12251D	Cable, double banana to BNC, 4 feet
12252D	Cable, Shielded, double banana to test probe
	Battery Replacement Kit P/N 89104221A

TABLE 1–4. OPTIONS

Options		Factory Installed	Field Installed
01	Parallel BCD Printer Output	Yes	No
05	Internal Rechargeable Battery Pack with charger. 16 hour charge, 5 hour operation.	Yes	Yes
21	20 Ampere Current Range	Yes	No
30	120V AC Adapter 60 to 400 Hz	Yes	Yes
31	230V AC Adapter 50 to 400 Hz	Yes	Yes

TABLE 1–5. OPTION INCOMPATIBILITY

Option	01	05	21	30	31
01	–	N	Y	Y	Y
05	N	–	Y	Y	Y
21	Y	Y	–	Y	Y
30	Y	Y	Y	–	N
31	Y	Y	Y	N	–

– = Not Applicable N = Not Compatible Y = Compatible

SECTION 2

INSTALLATION

2–1. INTRODUCTION.

2–2. This section contains information and instructions necessary for the installation and shipping of the instrument. Details are provided for initial inspection, power connection, grounding safety requirements, installation information, and repacking instructions for storage or shipment.

2–3. UNPACKING AND INITIAL INSPECTION.

2–4. Unpacking and initial inspection of the instrument requires only the normal precautions and procedures applicable to the handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to ascertain that the shipment is complete.

2–5. PERFORMANCE CHECKS.

2–6. This instrument was carefully inspected for mechanical and electrical performance before shipment from the factory. It should be free of physical defects and in perfect electrical order upon receipt. Check the instrument for possible damage incurred in transit and, if necessary, complete the performance checks outlined in paragraphs 5–13 through 5–19. If there is any indication of damage or improper operation, refer to the warranty included in this manual and notify your local Ballantine field engineering representative or the factory.

2–7. SAFETY CONSIDERATIONS

2–8. See Table 2–1 for the basic applicable safety requirements.

2–9. ALWAYS observe these safety considerations and cautions.

2–10. ALWAYS read and understand ALL of this manual for operator safety and to prevent damage to the sensitive diode detectors in the RF Comparator.

2–11. Power Requirements

2–12. This instrument may be operated from an external dc power source, from ac mains through Ballantine power converters and from internal rechargeable batteries.

2–13. DC Power Operation

2–14. This instrument is designed to operate from 9 to 14 volts dc. AC operation is available through optional Power Adapters. A rear panel mounted five-pin locking DIN receptacle is provided for connecting 9 to 14 volts dc at nominally 600 mA. The negative polarity is at rear panel COMMON connector ground potential. When using this dc power input cable a diode protects the instrument against accidental polarity reversal. A fuse is located within the instrument case. A dc power input cable is provided with each instrument. The instrument can not be floated "off battery" when using dc power operation.

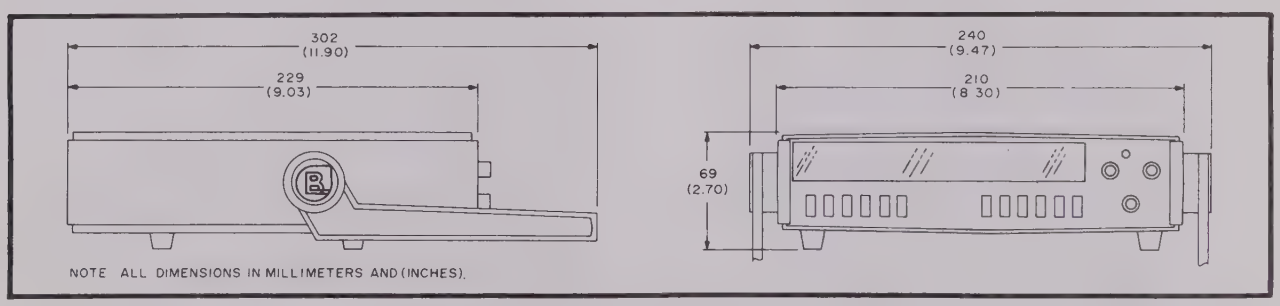


Figure 2–1. Model 3036A/B, Outline Dimensions

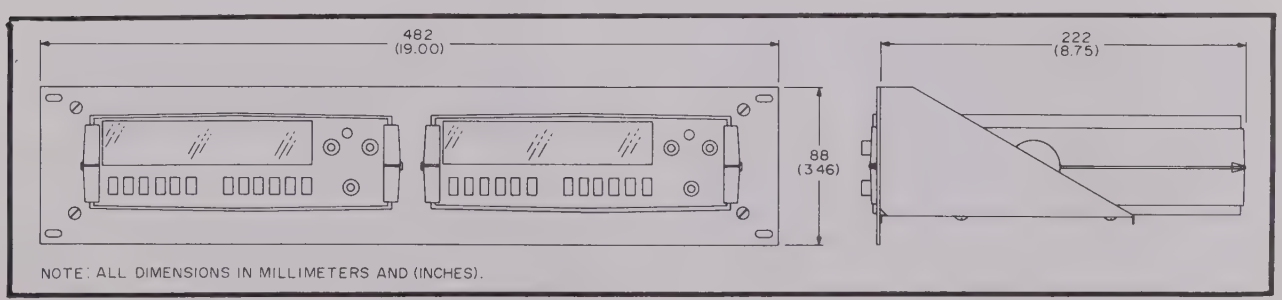


Figure 2–2. Rack Mount Kit, Outline Dimensions

2–15. Operation above 14 volts is permitted when a power resistor is connected in series with the positive dc power input lead. This power resistor must be rated at nominally 1.6 ohm per volt of drop above the first 10 volts of dc power input voltage. As an example, a +28 volt dc supply, which may rise to +32 volts, should have a 22-volt drop in the series power resistor (32 volts – 10 volts). Use a 33 to 36 ohm, 20 watt resistor for this dc input. Do not exceed 14 volts input without the series resistor since the instrument may be damaged and the warranty voided.

2–16. AC Power Mains Operation, Option 30 (120V) and Option 31 (230V).

2–17. AC power operation is available by the use of an optional ac Power Adapter which converts ac power to nominally 9.4 volts dc. P/N 85100691 (Option 30) is the 120 volt (103 to 126 V) ac rms adapter operating from 60 Hz to 400 Hz input power frequency. This adapter is a wall mount type which mates directly with American wall power receptacles and includes a third pin ground pin. The ground is provided for safety purposes and should be used at all times. When using the ac adapters, the COMMON input terminal may be floated to a maximum of ±500 V (dc + ac peak) with respect to earth ground. The adapter contains all ac power voltages and only low voltage dc is found in the instrument and the connecting power input cabling. This assures optimum operator safety and follows the safety requirements set forth by UL and O.S.H.A. Power Adapter P/N 85100701 (Option 31) is optionally available for 230 V ac rms (210 to 248 V) 50 Hz to 400 Hz ac power mains input. This unit is a bench mount type with a three wire input cable ready for installation of European type power mains plug.

CAUTION

The ac power adapters for this instrument are provided with a three-conductor power cord which will ground the case when connected to a three-connector grounding outlet. If a grounding outlet is not available, an adapter must be used which provides a good grounding connection. If batteries or dc input power are used the case should be properly grounded to an earth ground. Failure to use proper grounding may cause personnel hazard when the instrument is used with other electrical equipment.

2–18. The adapters should be operated from an ac power source with its neutral at or near ground (earth) potential. The instrument is not intended for operation from two phases of a multiphase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms) should be typically within the range of 1.3 to 1.6 at ±10% of the nominal rms line voltage. Use a true rms responding voltmeter, such as the Ballantine Model 3620A, to measure the power line voltage.

WARNING

The instrument is provided with a three-connector power cord which will ground the case when connected to a three-connector grounding outlet. If a grounding outlet is not available, an adapter must be used which provides a good grounding connection.

2–19. BATTERY OPERATION – Option 05.

2–20. The instrument may be operated from rechargeable nickel-cadmium batteries. The battery charger is standard and may be factory or field installed as Option 05.

2–21. Charge condition of internal batteries can be checked by removing power input and by simultaneously pushing the 20 Megohm and DCV push-buttons. Display reading should be above 5 volts or the batteries must be charged. Full charge will be obtained by applying ac power in the power off position for 14 hours.

2–22. As stated above, the 3036A may be operated either from 115 or 230 vac, 9 to 14 Vdc or internal batteries. The built-in charger provides full charge with power switch OFF and instrument power connected, or trickle-charge with power switch ON. The instrument may be operated from the ac or dc source with or without batteries installed.

2–23. GROUNDING REQUIREMENTS

2–24. To insure the safety of operating personnel, the U. S. Occupational Safety and Health Act (OSHA) and good engineering practice require that the instrument panel and enclosure be "earth grounded." All Ballantine instruments are provided with a three-conductor power cable assembly which, when plugged into an appropriate power receptacle, grounds the instrument. The offset pin on the male end of the power cable is the ground wire connection to the connector on the rear panel of the instrument.

2–25. To preserve the safety protection feature, when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green lead or terminal on the adapter to "earth ground."

WARNING

When using the instrument on external dc power or battery operation, use caution to avoid electrical shock and connect the instrument case to earth ground through the rear-panel grounding lug.

2–26. INSTALLATION AND MOUNTING

2–27. The instrument is fully solid-state and dissipates minimal heat. No special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 55°C (131°F) or when condensation due to high relative humidity appears anywhere on the instrument. The instrument is shipped ready for use as a portable or bench instrument. Outline dimensions are shown in Figure 2–1.

Note

Before using the instrument, exercise each of the pushbutton switches six or more times. This wiping action cleans switch contacts which may become noisy or intermittent during periods of storage or in contaminating environments.

2–28. The instrument case is provided with a carry handle which also serves as a tilt stand. To change the position of the handle, simply pull both sides of the handle outward from the case to disengage the detent mechanism; then, rotate the handle to the desired position, push the handle back toward the case and rotate slightly until it detents in place. The handle may be removed by firmly, but carefully, pulling both sides of the handle out of the detent mechanisms on the case.

2–29. Rack mounting capability for the instrument is provided by a rack adapter panel. Three 19-inch EIA rack-mount configurations are available. See Figure 2–2 for outline drawings.

2–30. REPACKAGING FOR SHIPMENT

2–31. If the instrument is to be repackaged for shipment, as a general guide, repackage the instrument as described in the following procedure and shown in Figure 2–3. Use either the original packing material, if available, or material similar to that specified. Proceed as follows:

a. Place the instrument accessories, if any, in a plastic bag and seal the bag.

Note

It is recommended that NiCad batteries be removed from the instrument if extreme environments or storage in excess of twelve months is anticipated.

b. For long distance shipping only, use U.S. Government packaging method IIC and tape a two-unit bag of dessicant (MIL-D-3464) on the rear cover.

c. Place a piece of sturdy cardboard over the front panel for protection. Enclose the instrument in a plastic bag and seal the bag.

d. Wrap the bagged instrument and accessories in 1-inch thick, flexible, cellular plastic-film, cushioning material (PP-B-795) and place in a barrier bag (MIL-B-131). Extract the air from the bag and heat seal.

e. Place the wrapped instrument and accessories into a fiberboard box (PPP-B-636) of suitable size. Fill spaces with rubberized hair or cellular plastic cushioning material. Close box in accordance with container specifications. Seal with sturdy water-resistant tape or with metal straps.

f. Mark contained "FRAGILE," "HANDLE WITH CARE," or similar precautionary notice. Affix shipping labels as required or mark according to MIL-STD-129.

Note

If the instrument is to be shipped to Ballantine for calibration or repair, attach a tag to the instrument identifying the owner. Note the problem, the symptoms, and service or repair desired. Record the model and serial number of the instrument. Show the work authorization order as well as the date and method of shipment.

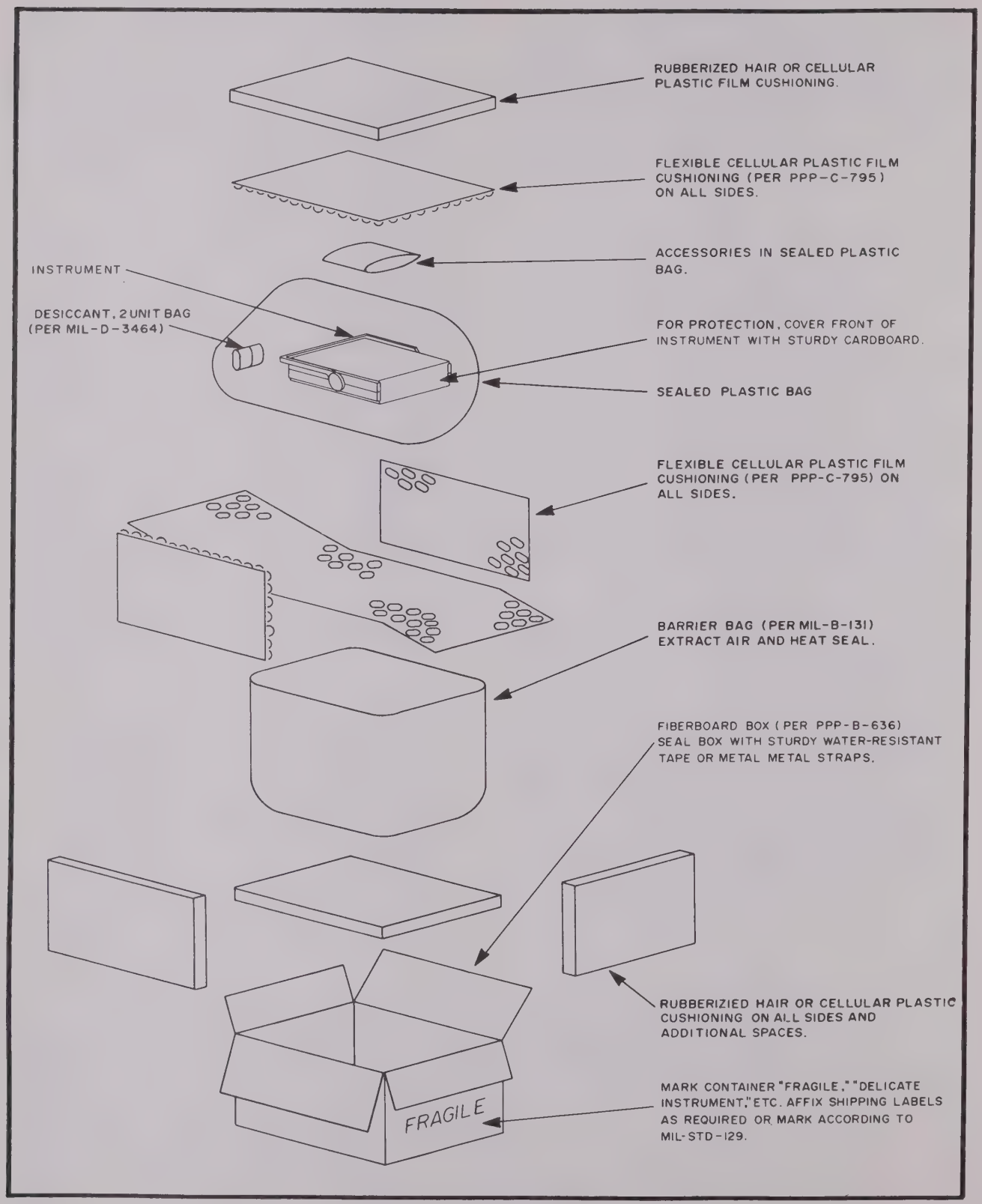

RUBBERIZED HAIR OR CELLULAR PLASTIC FILM CUSHIONING.
FLEXIBLE CELLULAR PLASTIC FILM CUSHIONING (PER PPP-C-795) ON ALL SIDES.
ACCESSORIES IN SEALED PLASTIC BAG.
INSTRUMENT
DESICCANT, 2 UNIT BAG (PER MIL-D-3464)
FOR PROTECTION, COVER FRONT OF INSTRUMENT WITH STURDY CARDBOARD.
SEALED PLASTIC BAG
FLEXIBLE CELLULAR PLASTIC FILM CUSHIONING (PER PPP-C-795) ON ALL SIDES.
BARRIER BAG (PER MIL-B-131) EXTRACT AIR AND HEAT SEAL.
FIBERBOARD BOX (PER PPP-B-636) SEAL BOX WITH STURDY WATER-RESISTANT TAPE OR METAL METAL STRAPS.
RUBBERIZIED HAIR OR CELLULAR PLASTIC CUSHIONING ON ALL SIDES AND ADDITIONAL SPACES.
FRAGILE
MARK CONTAINER "FRAGILE," "DELICATE INSTRUMENT," ETC. AFFIX SHIPPING LABELS AS REQUIRED OR MARK ACCORDING TO MIL-STD-129.

Figure 2–3. Packing Diagram

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed considering IEC Publication 348 and ANSCI C39.5, "Safety Requirements for Electronic Measuring Apparatus".

This manual contains information, cautions, and warnings which must be followed by the service person to ensure safe operation and to retain the instrument in safe condition.

WARNINGS

SAFETY

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

GROUNDING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

HIGH VOLTAGE

Warning — These servicing instructions are for use by qualified personnel only. To avoid dangerous electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

CAUTIONS

LINE VOLTAGE SELECTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source. Verify that the power transformer primary is matched to the available line voltage. Verify that the correct fuse is installed.

GROUNDING

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

⚠ ATTENTION ⚠

This symbol: ⚠, which appears on the instrument means: Read the instruction manual before operating the instrument. If the instrument is operated without reading the instructions, it may not operate correctly.

SECTION 3

OPERATION

3–1. INTRODUCTION.

3–2. This section contains instructions and information required for the operation of the instrument. Included are identification of controls, connectors, options and indicators.

3–3. CONTROLS, INDICATORS, AND CONNECTORS.

3–4. The controls, indicators, and connectors are identified in Figure 3–1 and Table 3–1.

3–5. POWER REQUIREMENTS (AC, DC, AND INTERNAL BATTERY).

3–6. See paragraphs 2–11 through 2–22. For grounding and safety earth connections see paragraphs 2–23 through 2–25.

3–7. OPERATING INSTRUCTIONS

3–8. Figures 3–2 through 3–7 outline instructions for making measurements with the Model 3036A/B. Each figure discusses a particular mode of operation. The number associated with each control indicate the step in which the control is being used.

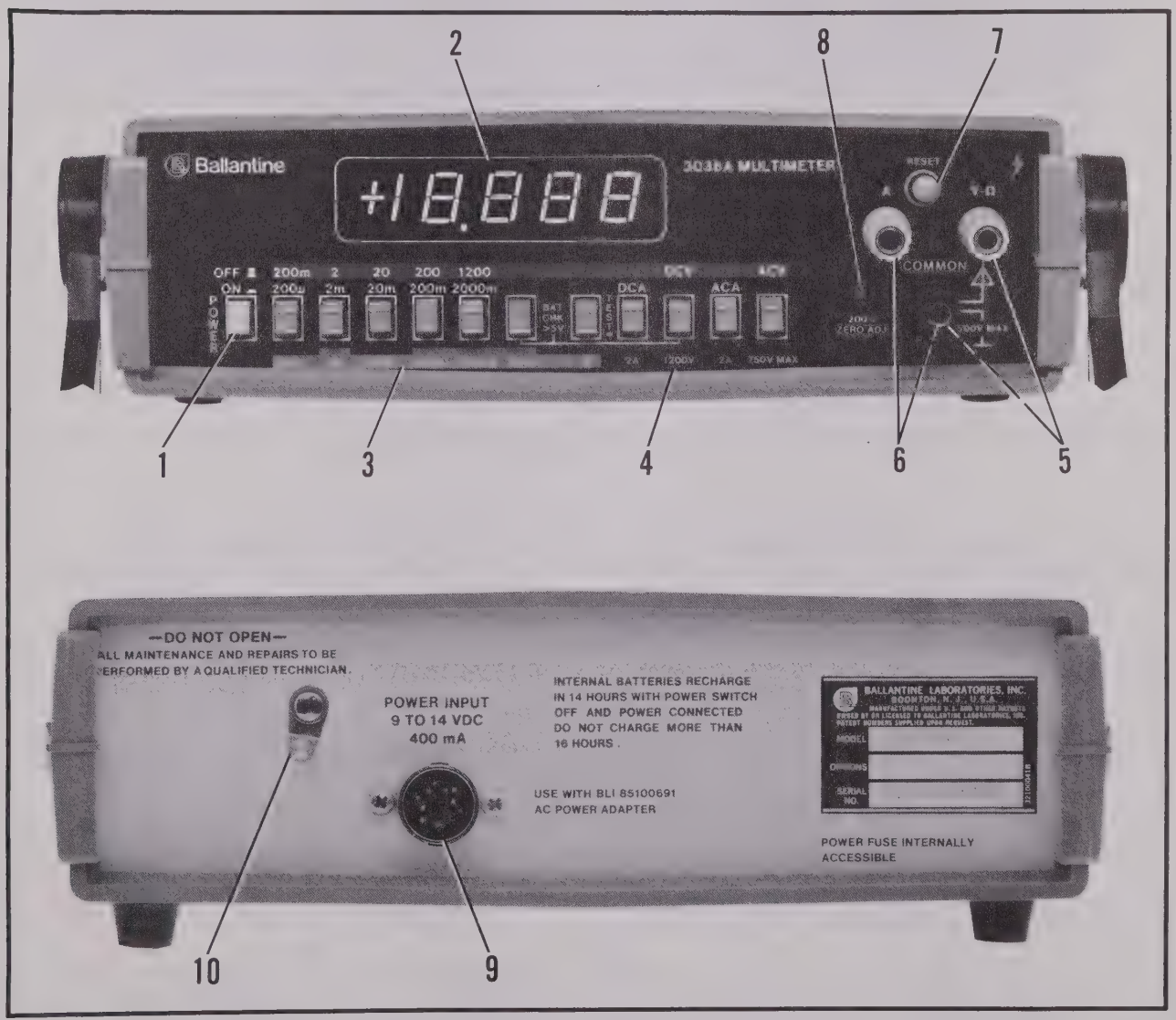


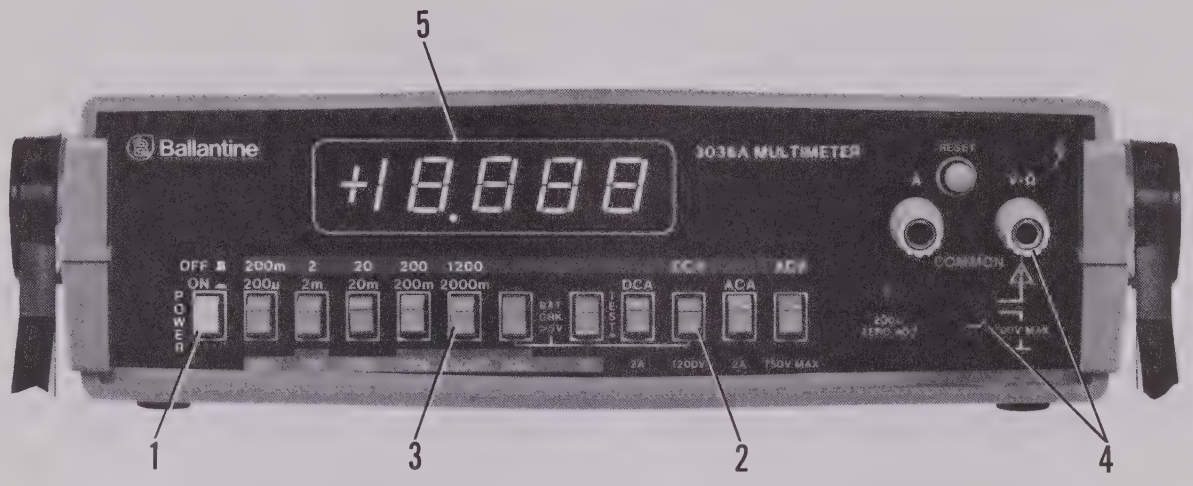
Figure 3–1. Controls, Connectors and Indicators.

TABLE 3–1. MODEL 3036A/B, CONTROLS, INDICATORS, AND CONNECTORS

INDEX NO.	CONTROLS, INDICATORS OR CONNECTORS	DESCRIPTION
1	POWER Switch	Switches instrument power ON or OFF. Power is ON when the pushbutton is depressed.
2	Display	Digital readout, 5 sections. Four seven-segment LED's and 1, plus a polarity indicator.
3	RANGE Switches	Select one of five voltage ranges and one of six current or resistance ranges.
4	FUNCTION Switches	Select one of five measurement functions: ACV, DCV, DCA and Kohm.
5	VOLT-OHM Input Terminals	Used in conjunction with the COMMON terminal for measuring ac voltage, dc voltage or ohms.
6	A Terminal	Used in conjunction with the COMMON terminal for measuring ac or dc current.
7	Reset	Circuit Breaker. Push to reset for current overloads >2A.
8	ZERO Adjustment	Screwdriver display ooo adjust for the 200 mV and 200 Ω ranges.
9	Power Receptacle	5 pin DIN locking receptacle for power input of 9 to 14 volts dc.
10	Ground Lug	Ground connection to case.

TABLE 3–2. MODEL 3036A/B MAXIMUM ALLOWABLE INPUT OVERLOAD CONDITIONS

SELECTED FUNCTION	SELECTED RANGE	MEASUREMENT INPUT CONNECTION	MAXIMUM INPUT OVERLOAD LIMITS
DCV	200mV, 2, 20, 200, or 1200V	V-Ω and COMMON	1200V dc or 1200V ac rms (sinusoidal)
ACV	200mV, 2, 20, 200, or 1200V	V-Ω and COMMON	750V rms (sinusoidal) not to exceed 10^7 V-Hz
DCA, ACA	200μ, 2, 20, 200, or 2000mA	A and COMMON	2A (circuit breaker protected)
KΩ	200Ω, 2, 20, 200, 2000KΩ or 10MΩ	V-Ω and COMMON	285V rms
Any	Any	Earth Ground and COMMON	1200V peak – Internal Battery Operation 500V peak – Opt. 30, 31 ac power adapters



1. Set POWER switch to ON.
2. Set FUNCTION switch to DCV.
3. Set RANGE switch to 2000 or the desired lower range if known.
4. Connect unknown DC Voltage across V-Ω and COMMON terminals. Reduce range until proper reading is reached.
5. Read voltage on display. Decimal point is correctly positioned.

NOTE

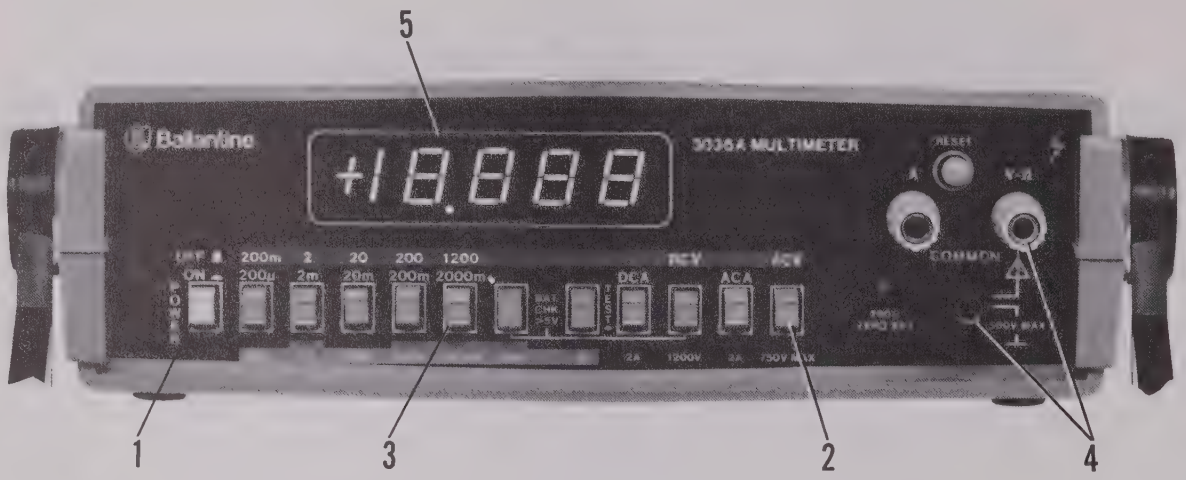
A flashing display indicates overload. Switch the appropriate range switch to the next higher range until a steady display appears.

Unit may be used up to 50% overrange on all ranges but not to exceed 1200V. For example, 230V would be displayed as 30.00 on the 200V range with a flashing display.

CAUTION

The measuring circuit is floated from the enclosure ground of the instrument. The potential applied between COMMON and ground must not exceed 500V (dc and peak ac) when using ac power adapters or damage to the instrument may result.

Figure 3–2. DC Voltage Measurements.



1. Set POWER switch to ON.
2. Set FUNCTION switch to ACV.
3. Set RANGE switch to 2000 or the desired lower range if known.
4. Connect unknown AC voltage across V-Ω and COMMON terminals. Reduce range switch until proper reading is reached.
5. Read voltage on display. Decimal point is correctly positioned.

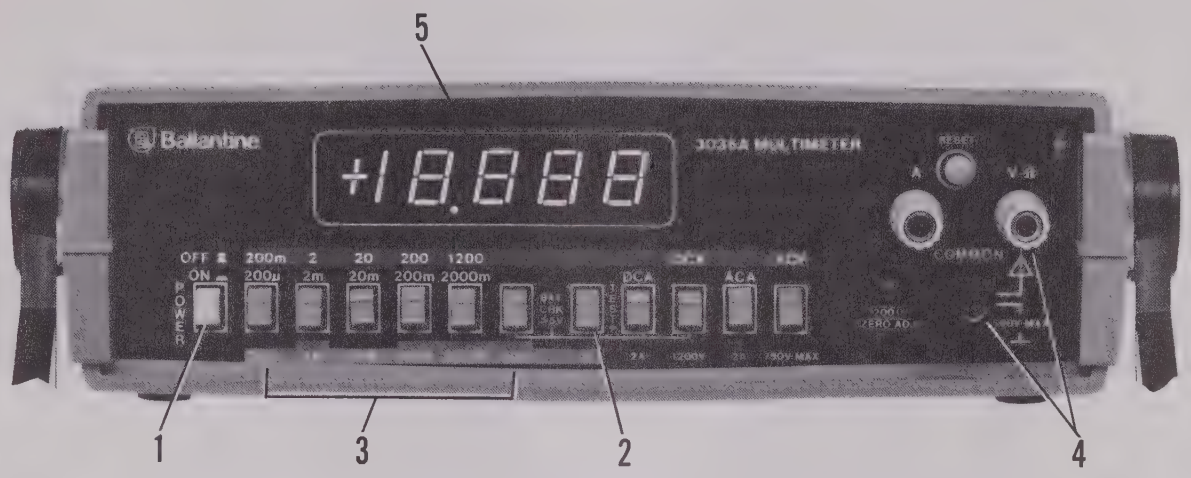
CAUTION

Maximum allowable input voltage is frequency dependent. Do not exceed 10^7 V-Hz product.

NOTE

A flashing display indicates overload. Switch the appropriate range switch to the next higher ranges until a steady display appears.

Figure 3–3. AC Voltage Measurements.



1. Set POWER switch to ON.
2. Set FUNCTION switch to kΩ.
3. Set RANGE switch to the desired range. The 20 MΩ range is selected by setting the kΩ and 20 MΩ switches.
4. Connect unknown resistance across V-Ω and COMMON terminals. Select range switch until proper reading is reached.
5. Read resistance on display. Decimal point is correctly positioned.

CAUTION

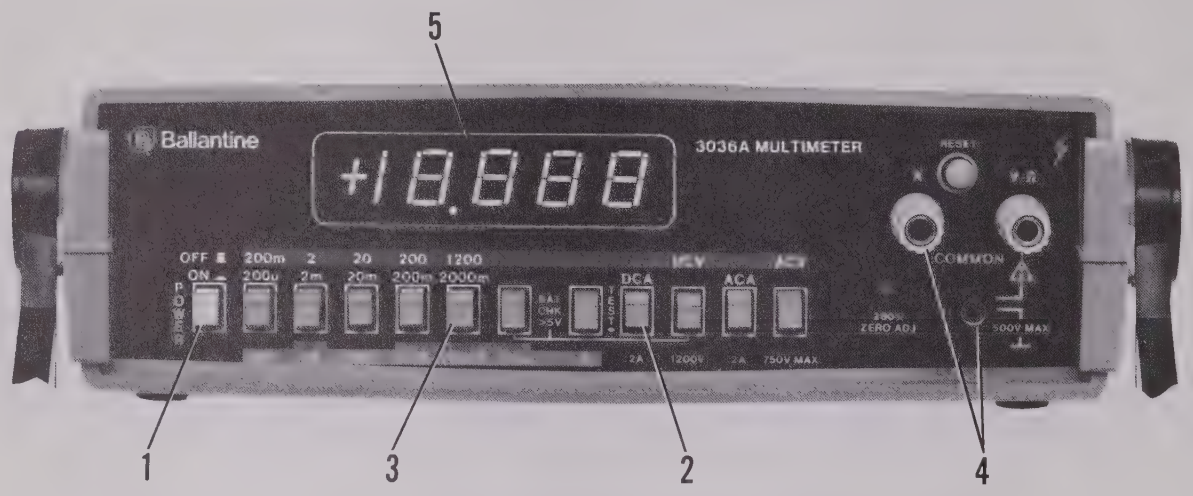
The resistance measuring circuitry is protected against the application of voltages of up to 250 volts (DC & PEAK AC). Always turn off power from the circuit being measured when making "in circuit" resistance measurements. Voltage in excess of 250V will damage the instrument.

NOTES

1. When using the 200 ohm range for low resistance measurements, the resistance of the multimeter leads will cause error of about 0.2 ohm. Subtract this error from the reading or adjust the 200Ω range ZERO screwdriver adjust on the front panel for a display of 000.0 when the test leads are shorted together.
2. Flashing display indicates overload. Switch the appropriate range switch to the next higher range until a steady display appears.

   Unit may be used up to 50% overrange on all ranges. For example, 250 kΩ would be displayed as 50.00 on the 200 kΩ range with a flashing display.

Figure 3–4. Resistance Measurements.



1. Set POWER switch to ON.
2. Set FUNCTION switch to DCA.
3. Set RANGE switch to 2000 or the desired lower range if known.
4. Connect unknown dc current across A and COMMON terminals. Reduce range switch until proper reading is reached.
5. Read dc current on the display. Decimal point is correctly positioned and polarity indicated.

NOTE

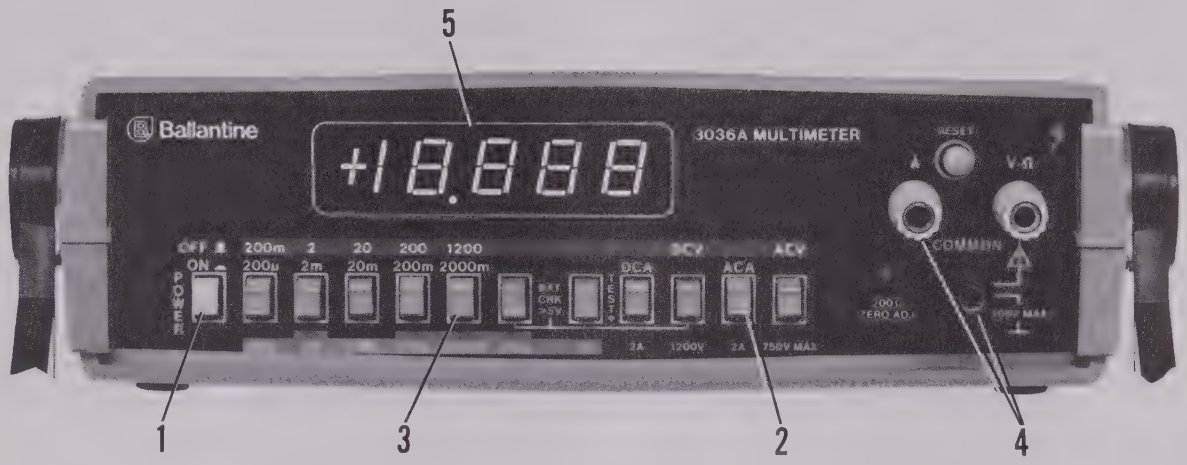
A flashing display indicates overload. Switch the appropriate range switch to the next higher range until a steady display appears.

Unit may be used up to 50% overrange on all ranges but not to exceed 2A. For example, 250 mA would be displayed on 50.00 on the 200 mA range with a flashing display.

CAUTION

A current in excess of 2A, applied across the A and COMMON terminals will trip the circuit breaker. If the breaker trips, its reset button will extend farther from the panel. To reset, simply push the RESET button. DO NOT apply peak currents exceeding 15 Amperes.

Figure 3–5. DC Current Measurements.



1. Set POWER switch to ON.
2. Set FUNCTION switch to ACA.
3. Set RANGE switch to 2000 or the desired lower range if known.
4. Connect unknown ac current across A and COMMON terminals. Reduce range switch until proper reading is reached.
5. Read ac current on the display. Decimal point is correctly positioned.

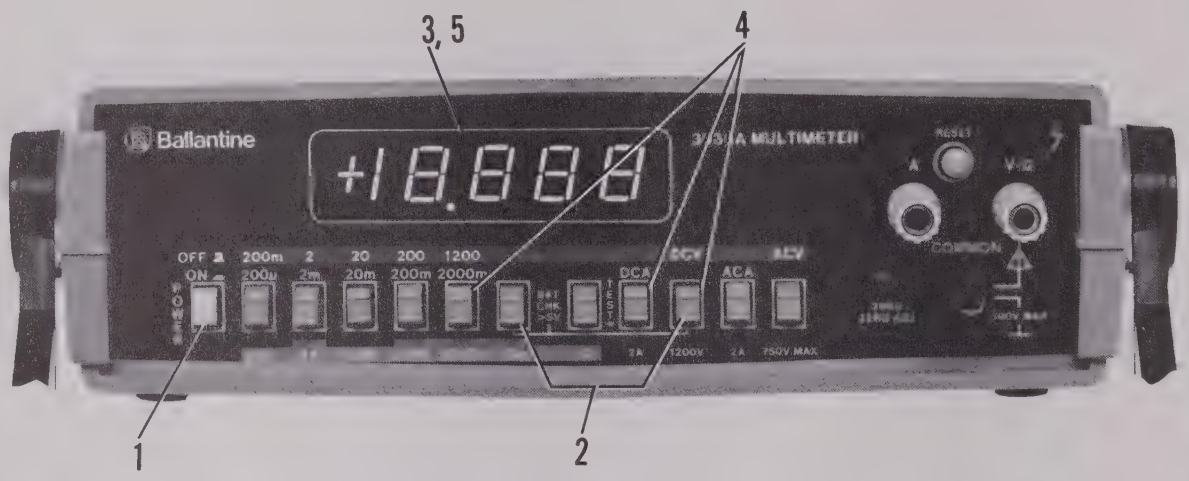
NOTE

A flashing display indicates overload. Switch the appropriate range switch to the next higher ranges until a steady display appears.

CAUTION

A current in excess of 2A applied across the A and COMMON terminals will trip the circuit breaker. If the breaker trips, its reset button will extend farther from the panel. To reset, simply push the RESET button. DO NOT apply peak currents exceeding 15 Amperes.

Figure 3–6. AC Current Measurement.



1. Set POWER switch to ON.

2. Push DCV and 20 MΩ range.

3. Note display reading, above 5.000 is exceptable. Below 5.000 reading indicates discharged batteries. Recharge batteries as described in paragraph 2–21.

4. Push DCV and DCA simultaneously and 2000V range.

5. Display reading should be +888.8.

NOTE

When operation on batteries, do not leave instrument in display test position for a long period. This may result in rapid battery discharge.

Figure 3–7. Battery and Display Check.

SECTION 4

THEORY OF OPERATION

4–1. INTRODUCTION

4–2. This section of the manual contains a description of the circuitry used in the 3036A. Figure 4–1 is a detailed block diagram of the instrument. Basically, the diagram can be broken down into 5 functional areas. These are: DC voltmeter circuit, Ohm converter, current shunts, AC converter circuit and power supply.

A complete schematic is given at the rear of this manual. Refer to this diagram throughout the following circuit description.

4–3. DC VOLTMETER CIRCUIT–(dc to digital converter)

4–4. The DC input voltage is coupled to the analog processor U5 via a precision attenuator and a two-section low-pass filter comprising R26, C9 and R27, C8. The input voltage to the processor is limited by voltage limiters. Diodes CR6, CR9 limit the positive voltage swing, while diodes CR7, CR8 limit the negative voltage swing. Ranging resistors in the attenuator are selected by the front panel RANGE switches to provide a 200 millivolt maximum voltage for the 200 mV and 20V ranges and a 2 volt maximum voltage for all other ranges.

The monolitic analog processor contains a bipolar comparator, a bipolar integrating amplifier, two MOS-FET input unity gain amplifiers, several analog switches and the necessary level shifting drivers to allow the analog and digital processors to be directly interfaced.

The digital processor U6 combines the counting, storage and data multiplexing functions with the random logic necessary to control the function of the analog processor. Output buffers provide the sign, digit strobe and multiplexed BCD data outputs. The digit scan is an interlace format of digits 1, 2, 3, 4 and 5.

4–5. A measurement cycle consists of two parts: the measure interval and the auto-zero interval. In the measure interval a conversion technique balances the charge supplied by a current proportional to the input voltage with an accumulation of quantized charges equal to a BCD count. The units of quantized charge are provided through pulse-width modulation of a reference current.

The auto-zero interval allows the effect of offset, temperatures and drift to be impressed on the auto-zero storage voltage, which is maintained as a reference by the capacitor C11. Therefore, during the succeeding measure interval these effects will be balanced out. The input of the buffer amplifier is grounded during this interval.

4–6. The digital processor has a built-in overrange flashing circuit. The presence of a count of 20000 or greater in the BCD counter causes the 4½ digit display to blink off during the zero cycle resulting a leak rate equal to the sampling rate.

4–7. The decoder driver U7 translates the BCD information from the digital processor to drive the cathodes of the LED readouts DS2, DS3, DS4 and DS5. The anodes are controlled by the digital processor U6 driving the transistors Q11 thru Q20. The digit-strobe pulses from U6 determine which readout receives the proper anode voltage at the proper time. The most significant digit is readout DS1. Two segments are used to form a numerical "1" and two other segments form the plus or minus polarity signs. The "1" segments are driven by transistors Q7 and Q8, while the polarity signs are driven by Q5 and Q6. The decimal point illumination is controlled by U8, Q9 and Q10 with the RANGE switches S2B, S3B, S5B and S6A.

4–8. Timing signals for the analog and digital processors are generated by the free-running oscillator Q21, L1, C13, C14, R46 and R47.

4–10. DC AND AC CURRENT CIRCUIT

4–11. Direct current is measured by monitoring the voltage drop caused by the unknown current flowing through the precision shunt resistors R13 thru R18. In each of the ranges shunt resistances are selected to give a full scale voltage of 200 mV to the DC circuit.

4–12. The shunts are protected from damage due to excessive current by a combination of diode-clamps and circuit breaker. Bridge rectifier CR11 is used to clamp and divert excessive positive and negative currents. If current through the shunts exceeds 2 Amps, the circuit breaker will open to protect the multimeter.

The operator should set up all current measurements with this in mind. Do not exceed 15A peak current. Similarly, AC currents are measured by measuring the voltage drop across the shunt resistors. This voltage is then passed through the AC to DC converter and measured by the dc to digital converter.

4–13. OHMS CONVERTER CIRCUIT

4–14. Resistance is measured by programming a constant current through the unknown resistance and measuring system. A feedback circuit consisting of bootstrap amplifier U3 a constant current regulator consisting of Q2 and Q3 and ranging resistors, act as a constant current generator to supply a test current of 1 mA for the 199.99 ohms and 1.9999 KΩ ranges, 10 μA for the 19.999 KΩ range, 10 μA for the 199.99 KΩ range, 1 μA for the 19999 KΩ range and 100 nA for the 19.999 MΩ range. The bootstrap amplifier output is equal to the voltage at the analog processor input U5 (pin 15) plus 1 volt generated by the voltage drop across R22 caused by the precision 1 mA constant current source. The test current through the unknown resistance is therefore 1V/Range.

4–15. The constant current generator comprises U4, Q1 and Q29. Zener diode CR4 provides a reference voltage of 6.2 volt. This voltage causes a constant voltage drop across R23 and R24 resulting in a constant current of 1 mA to flow in the collector circuit of Q1. U3 is a FET-input high-performance operational amplifier and the current drawn by its input is negligible.

4–16. The overload protection circuit for the ohms converter comprises CR3, CR5, Q1, Q29 and Q3. Positive voltage will reverse bias CR5, Q29 and Q1 which will act like an open switch. Negative voltage will referse bias CR3 and Q3 which will act like an open switch.

4–17. AC-DC TRUE RMS CONVERTER CIRCUIT

4–18. The AC-DC converter consists of U1 and wideband tru rms converter U2. Series capacitors C1 and C3 blocks DC voltages so that only AC voltages are measured. U1 is being used as an impedence converter and as a source follower with unity gain for ranges 2,200 and 500 V. For 200 mV and 20V ranges U1 is used as an amplifier with gain of 10. Gain of 10 is obtained when switches S1B and S3A are closed. In each of the ranges the gain of U1 is selected to give a full scale rating of 2V in the dc to digital converter circuit.

4–19. The overload protection circuit for the AC-DC converter comprises R9, CR1 and CR2. Voltage above and below 12V peak will be clamped by CR1 and CR2. The voltage then will drop on R9.

4–20. POWER SUPPLY

4–21. The power supply circuit provides a regulated plus and minus 12 volt source for the analog and reference circuitry and a regulated +5V source for the timing, digital processor and display circuits.

4–22. The input dc power voltage is applied in parallel to the input of a +5 volt regulator U20 and a constant current regulator consisting of Q28 and Q22. With the POWER switch in the OFF position, transistor Q28 senses the voltage drop across resistor R70 and regulates the constant charging current supplied to the batteries (option 05).

4–23. With the POWER switch ON, the optional batteries are trickle-charged with charging current limited by resistor R73. Voltage regulator U20 supplies a constant +5V to operate the instrument.

4–24. The optional rechargeable battery supply powers the DMM whenever line voltage is removed or drops below the minimum needed to drive regulator U20. Four NiCad cells are the battery power source.

4–25. The four batteries are wired in series to provide nominally 4.8V. Q23 acts as the battery cutout switch to guard against battery reversal and to automatically switch the batteries out of the circuit when power is supplied through U20.

WARNING

Use only nickel cadmium cells to power the Model 3036A. Use of alkaline or carbon zinc cells may cause damage and void the warranty.

4–26. To charge the batteries the POWER pushbutton is set OFF and the ac or dc input power is applied. The batteries are charged by the constant current source described above. The instrument is not operating when batteries are being charged.

4–27. The dc to dc converter consists of a solid state switch Q24 and differential amplifier Q26 and Q27. The pulses generated are rectified by diodes CR22 and CR24. Capacitors C24 and C25 filter the rectified voltages of +15 and -15 V dc.

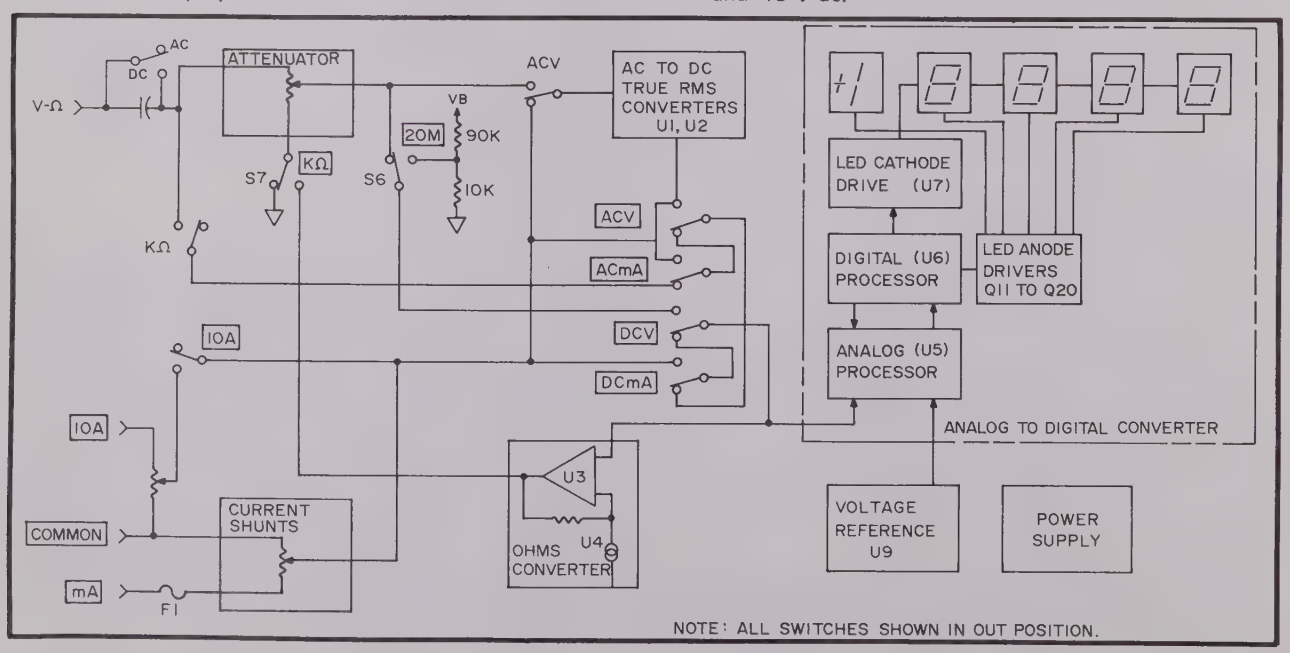


Figure 4–1. Block Diagram

SECTION 5

MAINTENANCE AND CALIBRATION

5–1. INTRODUCTION.

5–2. This section contains information required to maintain the instrument within specifications. The following paragraphs detail:

a. Performance Assurance Checks.

b. Calibration Procedures.

c. Fault Finding (Troubleshooting) details.

d. Preventive Maintenance.

5–3. The instrument is designed with premium components. Like other Ballantine instruments, it will provide many years of satisfactory service. Ballantine recommends that performance assurance checks and preventive maintenance procedures be performed on the following schedule:

a. Routine laboratory service every 12 months or 1,000 hours of use whichever comes first.

b. Service in the field or in extended environments every six months or 450 hours of use whichever comes first.

5–4. Full NBS traceable calibration should be performed once each year. Normally the user will provide recalibration services in his plant. If required, Ballantine will gladly provide this calibration service at our Boonton, N.J. service center for a nominal charge.

5–5. REQUIRED TEST EQUIPMENT.

5–6. Table 5–1 provides a list of test equipment required to properly check, calibrate, and maintain the instrument. Equivalent test equipment meeting all the minimum requirements may be substituted if the recommended items are not available.

TABLE 5–1. REQUIRED TEST EQUIPMENT

Instrument Type	Purpose	Recommended Model	Specifications
DC Voltage Calibrator	DC Voltage Calibration	Fluke 332B	1.0 mV to 1100 V dc. Five-digit resolution. 0.03% accuracy.
AC Voltage Calibrator	AC Voltage Calibration	H-P745A/746A or Fluke 5200/5215	1.0 mV to 1100 V ac. 10 Hz to 110 kHz. Five-digit resolution. 0.05% accuracy.
DC Current Calibrator	DC Current Calibration	Fluke 382A or 760A	10 μA to 1 A dc. Five-digit resolution. 0.05% accuracy.
Resistance Standard	Ohmmeter Calibration	Shallcross 883	10Ω to 10 MΩ. ±0.1% accuracy. Decade dials.
AC/DC True RMS Voltmeter	Line Voltage Measurement	Ballantine 3620A	10 mV to 1 kV, dc and ac true rms. 0.25% accuracy. 4½-digit resolution. 1 μV resolution.
Digital Multimeter	Troubleshooting Tool	Ballantine 3028B	DC volts to 1.2 kV. AC volts to 1.2 kV. 20 Hz to 100 kHz. LOΩ, 100 to 2 MΩ. HIΩ, 1 kΩ to 20 MΩ. AC current to 2A. DC current to 2 A. 3½ digits.
Oscilloscope with probes	Troubleshooting Tool	Ballantine 1010A with 10601C probes	Dual Trace. 5 mV, dc to 15 MHz. 100 ns/cm to 1 sec/cm. 10:1 divider probes.
AC Current Source	AC Current Calibration	Fluke 760A	10 μA to 1 A, ac ±0.2% accuracy.
Line Control Variac	Set Line Voltage	General Radio W5MT3AW	0 V to 135 V (0 V to 270 V).
Frequency Counter	Check A to D Clock frequency	Ballantine 5720A or 5500B	8 digits, 10 Hz to 1 MHz.

5–7. PERFORMANCE ASSURANCE CHECKS.

5–8. The performance assurance checks are "in-cabinet" checks that compare the instrument with the applicable performance specifications. The sample performance test record, Form 5–1, may be used or duplicated to provide permanent performance test records. Beginning with incoming inspection checks, periodic performance assurance checks should be made in the sequence detailed below and before any attempt is made to calibrate the instrument. The performance assurance checks should also be used as part of the troubleshooting procedure and before returning the instrument to regular service after repair, recalibration, or extended storage. *All checks are made at 23°C ±2°C and with COMMON connected to power line earth ground. Use ac or dc or internal battery.*

Note

Prior to making any of the following performance assurance checks set ac line voltage to 120 volts. If battery power is used, charge batteries at least 8 hours. Exercise each of the pushbuttons several times to clean switch contacts by self-wiping action.

5–9. Power Supply and Display Check.

5–10. To check the power supply regulation and the display proceed as follows:

a. Connect the instrument with ac power adapter to the ac mains through a Variac voltage control unit. Monitor ac voltage with the true rms responding ac voltmeter. DC power input from an external power supply is also acceptable.

b. Set DMM pushbuttons as follows:

Function	ACA
Range	200μ

c. Set ac mains voltage to 120 ±2 volts (or 230 ±4 volts) if using dc power input, apply 9.4 volts.

d. Depress POWER pushbutton switch to "ON".

e. Observe that the digital display reads 00.00 to 00.03.

f. Depress DCV and DCA pushbuttons simultaneously.

g. Observe that the digital display reads 8888 as an indication that the display performs satisfactorily.

h. Release pushbutton but depress pushbutton to retain current function.

i. Lower mains voltage to 102V (or 8.5V dc) and observe that the DMM display does not change. This checks low line voltage operation.

j. Raise mains voltage to 130 volts (or +10%) and observe that the DMM display does not change. This checks high line voltage operation. Reset power to 120 volts (or 230V or 9.4V dc).

5–11. Battery Check – Option 05.

Note

This battery check is required only when a rechargeable battery option, such as Option 05, is installed.

a. Continue as in Step 5–10(j) but disconnect ac power cable from the rear panel receptacle of the DMM. Connect earth ground to rear panel ground lug.

b. Observe that the batteries power the unit and that the display does not change.

c. Depress pushbutton.

d. Depress the DCV and DCA pushbuttons simultaneously.

e. Observe that the display reads greater than 5000 to indicate that the batteries are charged. Fully charged batteries will check at above 5.350.

5–12. DC Voltage Accuracy Check.

5–13. To check the dc voltage accuracy of the instrument proceed as follows:

a. Set function pushbutton switch to DCV.

b. Set POWER pushbutton switch to "ON".

c. Depress range pushbutton switch for 200 mV.

d. Connect a short across the V–Ω and COMMON input connectors.

e. Note a display reading of 0.000 ±3 counts.

f. Depress 20 mV.

g. Set ZERO screwdriver adjust for 0.000 ±3 counts.

h. Remove the short from V–Ω and COMMON.

i. Connect the DC voltage calibrator positive output to the V–Ω input connector of the DMM and connect the negative calibrator output to the COMMON connector.

j. Proceed to check dc voltage accuracy at each setting of the voltage calibrator listed in Table 5–2. In each case the digital readout display of the DMM should be within the tolerance shown.

k. For negative readings reverse input leads at the DC voltage calibrator.

5–14. DC Current Accuracy Checks.

5–15. Set the DMM controls as follows:

a. Power	ON
b. Function	DCA
c. Range	200 m

5–16. Connect the A input connector of the DMM to the positive output of the dc current calibrator and the COMMON input connector to the negative terminal of the current calibrator.

5–17. Check the accuracy at each setting of the dc current calibrator listed in Table 5–3. In each case the displayed readout must be within the tolerances shown.

5–18. AC Voltage Accuracy Checks.

5–19. Set the DMM controls as follows:

a. Power	ON
b. Function	ACV
c. Range	1200

5–20. Connect the ac voltage calibrator to the V–Ω and COMMON input connectors of the DMM.

5–21. Check the accuracy at each setting of voltage and frequency of the ac voltage calibrator as listed in Table 5–4. In each case the displayed readout must be within the tolerances shown.

5–22. AC Current Accuracy Checks.

5–23. AC current checks are optional. The current shunts within the instrument are used for both ac and dc. They are noninductive and have virtually no effect on frequency response which is determined by the ac to dc converter fully tested in paragraph 5–18 for ac voltage accuracy. Current accuracy is therefore checked for both ac and dc in paragraph 5–14. The following procedure is therefore given for reference only and need not be regularly performed. AC current accuracy checks are not required for the Performance Test Record Form 5–1.

5–24. Set DMM controls as follows:

a. Power	ON
b. Function	ACA
c. Range	2000 m

5–25. Connect the ac current calibrator to the A and COMMON input connectors of the DMM.

5–26. Check the accuracy at each setting of current and frequency of the ac current calibrator as listed in Table 5–5.

5–27. Ohms Ranges Accuracy Checks.

5–28. Set DMM Controls as follows:

a. Power	ON
b. Function	KΩ
c. Range	200 Ω

5–29. Connect the Resistance Standard to the V–Ω and COMMON input connectors of the DMM.

5–30. Check the resistance accuracy of the HIΩ and LOΩ ranges of the DMM at each setting of the resistance standard listed in Table 5–6. In each case the displayed readout must be within the tolerances shown.

5–31. CALIBRATION PROCEDURES.

5–32. If any of the Performance Assurance checks show an out-of-tolerance condition, recalibration will be required. Table 5–1 lists the test equipment required to completely calibrate and certify the instrument. If the instrument cannot be adjusted, refer to the troubleshooting and fault finding procedures beginning with paragraph 5–57.

Note

Only a qualified service technician with properly calibrated test equipment should service this instrument, since internal voltages may cause shock hazard. Calibrate at 23°C ±2°C and connect COMMON to earth ground.

5–33. Removal of Covers. The top and bottom covers of the plastic enclosure are fastened together by four screws which are accessible through the bumper feet at the bottom cover. To remove the covers first disconnect ac power cord. Then remove the handle by pulling carefully and firmly on the handle detents until both sides of the handle snaps out of their second detent. Then remove the four screws and carefully pull the top cover up and out from the side sections. Take care not to misplace the four spacer sleeves used to space the top cover on the side supports. These spacers support the unit and provide electrical connections for the metallic coating shield on the top cover and side supports. Always remove NiCad batteries at this point if Option 05 is installed. The side sections may then be removed by pulling up from the bottom cover. The front and rear panels will now be free of support. The printed wiring board may be separated from the bottom cover by removing the retaining screws accessible at the top of the printed wiring board.

Note

When making final calibration always have the bottom cover, panels, and side supports installed with proper electrical interconnection to the metallic coating since it serves as a guard shield to minimize unwanted noise pickup.

5–34. Preliminary Inspection.

5–35. Always check the voltmeter for mechanical damage, loose parts, faulty solder joints, burned resistors, etc. Use a low wattage (25 watts) grounded soldering iron to make repairs and always replace components with exact equivalents to be certain that all performance specifications can be obtained. Use heat shunts when soldering diodes and semiconductors. Do not overhead circuit board printed wiring and pads.

5–36. Internal Adjustments and Test Points.

5–37. See Figure 5–1 for the location of internal adjustments and test points.

TABLE 5–2. DC VOLTAGE ACCURACY CHECK

DC Voltage Standard	Range Switch Setting	3036B Readout Limits		3036A Readout Limits	
		Minimum	Maximum	Minimum	Maximum
0.0000	200 mV	± 00.00	± 00.02	± 00.00	± 00.02
±0.0100		± 00.99	± 01.01	± 00.98	± 01.02
±0.1000		± 99.97	±100.03	± 99.94	±100.07
±0.1900		±189.95	±190.05	±189.87	±190.13
0.0000	2 V	± .0000	± .0002	± .0000	± .0002
±1.0000		± .9997	±1.0003	± .9994	±1.0007
±1.9000		±1.8995	±1.9005	±1.8987	±1.9013
+10.000	20 V	9.997	10.003	± 9.994	±10.007
+19.000		18.995	19.005	±18.987	±19.013
+100.00	200 V	± 99.97	±100.03	± 99.94	±100.07
+190.00		±189.95	±190.05	±189.87	±190.13
+ 500.0	1200 V	± 499.7	± 500.3	± 499.6	± 500.4
+1000.0		± 999.5	±1000.5	± 999.4	±1000.7

TABLE 5–3. DC CURRENT ACCURACY CHECK

DC Current Calibrator (milliamps)	Range Switch Setting	3036B Readout Limits		3036A Readout Limits	
		Minimum	Maximum	Minimum	Maximum
0.0000	200 μA	± 00.02	± 00.02	± 00.00	± 00.02
±0.0100		± 00.99	± 01.01	± 00.98	± 01.02
±0.1000		± 99.89	±100.11	± 99.79	±100.21
±0.1900		±189.79	±190.21	±189.59	±190.41
±1.0000	2 mA	± .9989	±1.0011	± .9979	±1.0021
±1.9000		±1.8979	±1.9021	±1.8959	±1.9041
±19.000	20 mA	±18.979	±19.021	±18.959	±19.041
±190.00	200 mA	±189.79	±190.21	±189.59	±190.41
±1900.0	2000 mA	±1897.9	±1902.1	±1895.9	±1904.1

TABLE 5–4. AC VOLTAGE ACCURACY
(COMMON tied to earth ground lug on rear panel)

AC Voltage Calibrator		DMM				
			3036A		3036B	
Voltage	Frequency	Range	Low Limit	High Limit	Low Limit	High Limit
0000 (Short)	500 Hz	200 m	00.00	00.05	00.00	00.05
100.00 mV	500 Hz	200 m	99.40	100.60	99.70	100.30
190 mV	500 Hz	200 m	188.80	191.20	189.52	190.48
190 mV	20 kHz	200 m	188.80	191.20	188.80	191.20
1.900 V	30 Hz	2	1.8805	1.9195	1.8805	1.9195
1.900 V	500 Hz	2	1.8880	1.9120	1.8952	1.9048
1.900 V	20 kHz	2	1.8880	1.9120	1.8880	1.9120
19.00 V	500 Hz	20	18.880	19.120	18.952	19.048
19.00 V	20 kHz	20	18.880	19.120	18.880	19.120
190.0 V	500 Hz	200	188.80	191.20	189.52	190.48
190.0 V	20 kHz	200	188.80	191.20	188.80	191.20
750.0 V	500 Hz	1200	745.0	755.0	747.5	752.5
750.0 V	0 kHz	1200	741.4	758.5	741.4	758.5

TABLE 5–5. OPTIONAL AC CURRENT ACCURACY CHECK
(COMMON tied to earth ground lug on rear panel)

AC Current Calibrator		DMM	3036B Readout Limits		3036A Readout Limits	
Current	Frequency	Range	Minimum	Maximum	Minimum	Maximum
0000 (Short)	–	200 μ	00.00	00.05	00.00	00.05
100.00 μA	500 Hz	200 μ	99.60	100.40	99.25	100.75
190.00 μA	10 kHz	200 μ	189.23	190.77	188.62	191.38
1.9000 mA	30 Hz	2 m	1.8805	1.9195	1.8805	1.9195
1.9000 mA	500 Hz	2 m	1.8923	1.9077	1.8862	1.9138
1.9000 mA	10 kHz	2 m	1.8923	1.9077	1.8862	1.9138
19.000 mA	500 Hz	20 m	18.923	19.077	18.862	19.138
19.000 mA	10 kHz	20 m	18.923	19.077	18.862	19.138
190.00 mA	500 Hz	200 m	189.23	190.77	188.62	191.38
190.00 mA	10 kHz	200 m	189.23	190.77	188.62	191.38
1.9 A	500 Hz	2000 m	1892.3	1907.7	1886.2	1913.8
1.9 A	10 kHz	2000 m	1892.3	1907.7	1886.2	1913.8

TABLE 5–6. RESISTANCE ACCURACY CHECKS

Standard Resistance	DMM Range Switch Setting	3036B Readout Limits		3036A Readout Limits	
		Minimum	Maximum	Minimum	Maximum
00.00 (Short)	200 Ω	00.00	00.03 (Set)	00.00	00.03 (Set)
190	200 Ω	189.94	190.06	189.77	190.23
1.9 KΩ	2 KΩ	1.8994	1.9006	1.8977	1.9023
19 KΩ	20 KΩ	18.994	19.006	18.977	19.023
190 KΩ	200 KΩ	189.94	190.06	189.77	190.23
1.9 KΩ	2000 KΩ	1899.4	1900.6	1897.7	1902.3
19 MΩ	20 MΩ	18.989	19.011	18.957	19.043

5–38. Initial Power Supply Checks.

5–39. The DMM has no power supply adjustments but power input voltage regulation should be checked before calibration. Monitor the three dc power supply voltages of the DMM and observe voltages listed in Table 5–7 with a dc voltmeter.

TABLE 5–7. DC POWER SUPPLY LIMITS

Supply	Voltage Limits
+5	+4.30 to 5.60
+12	+11 to +14
−12	−11 to −14

5–40. Calibration.

5–41. All calibration is performed with ac power turned ON and ac mains voltage set to 12.0 volts (or 230 V ac or 9.4 V dc).

CAUTION

Always perform the calibration in the sequence indicated below.

5–42. Initial Check and Warm Up.

a. Push DCV and DCA simultaneously for display test reading of +8888.

b. Allow 20 minutes for warm up. Cover open unit to allow for normal heat rise.

5–43. Auto Zero Check (C15).

a. Push DCV and 1200V range.

b. Observe a display reading of +0000.0 ±1 LSD.

c. If displayed reading is out of tolerance select C15 until the specified display is observed. Choose capacitors in .2pF higher or lower values.

d. C15 does not require selection in normal maintenance but may require a different value when U5 or U6 are replaced.

5–44. ZERO OFFSET Adjust, R45.

a. Push DCA and 2000 m range.

b. With no leads connected to input A or COMMON adjust Zero offset (R45) to obtain a displayed reading of −0000.1 to +0000.1.

5–45. 2 Volt CAL Adjust, R32.

a. Push DCV and 2V range.

b. Apply +1.9V dc to the V-R and COMMON binding posts.

c. Adjust the 2 Volt CAC potentiometer (R32) to obtain a displayed reading of +1.9000 ±1 LSD.

d. Reverse the input leads to apply −1.9V dc. The displayed reading should be −1.9000 ±1 LSD or step 5–43 through 5–45 must be repeated.

5–46. 200 mV Range Adjust R37.

a. Push DCV and 200 m.

b. Connect −190 mV dc to the V–Ω and COMMON binding posts.

c. Adjust the 200 mV range adjust potentiometer (R36) to obtain a reading of +190.00 ±1 LSD on the display.

d. Reverse the input leads to apply −190 mV dc. The displayed reading should be −190.00 ±3 LSD or steps 5–44 and 5–46 must be repeated.

5–47. KΩ Adjust R24 and R23 Selection (3036A only).

a. Disconnect the DC voltage standard.

b. Push KΩ and 200 K range.

c. Set R24 to mid-range.

d. Connect a 190 KΩ standard resistor between the V–Ω and COMMON binding posts.

e. Note that the displayed reading falls within the range of 189.50 and 190.50. If not in this nominal range, select R23 until a reading of 189.75 to 190.25 is obtained with KΩ Adjust (R24) set to its mid-range.

f. Adjust KΩ Adj. potentiometer (R24) for a displayed reading of 190.00 ±2 LSD.

5–48. KΩ Range Verification and R1 Selection (3036A only).

a. Push KΩ and 1 KΩ range.

b. Connect 1.9 KΩ standard resistor to the V–Ω and COMMON binding posts.

c. Select R1 to obtain a displayed reading of 1.9000 ±1 LSD.

d. Check all KΩ ranges as indicated for the 3036A in Table 5–3 and if not within the listed specifications repeat steps 5–45 through 5–48.

5–49. ÷ 10,000 Attentuator Adjust R5 (3036B only).

a. Remove input leads from V–Ω and COMMON binding posts.

b. Push DCV and 200 mV.

c. Place a short between TP-0 and TP-1.

d. Connect a precision 1 volt dc source between TP-2 and COMMON.

e. Adjust the ÷ 10,000 attenuator adjust (R5) for a displayed reading of 100.00 ±1 LSD.

f. Remove the short between TP-0 and TP-1.

5–50. ÷ 1000 Attenuator Adjust R4 (3036B only).

a. Push DCV and 2000 V.

b. Apply 10 V dc between TP-3 and COMMON.

c. Adjust the ÷ 1000 Attenuator Adjust R4 to obtain a displayed reading of 1000.0 ±1 LSD.

5–51. ÷ 100 Attenuator Adjust R3 (3036B only).

a. Push DCV and 200 V.

b. Apply 10 V dc between TP-4 and COMMON.

c. Adjust the ÷ 100 Attenuator Adjust potentiometer (R3) to obtain a displayed reading of 10.000 ±1 LSD.

5–52. ÷ 10 Attenuator Adjust R2 (3036B only).

a. Push DCV and 1200 V.

b. Apply +1000 V dc to the V–Ω and COMMON binding posts.

c. Adjust the ÷ 10 Attenuator Adj. potentiometer R2 to obtain a displayed reading of +1000.0 ±1 LSD.

d. Disconnect the DC Voltage Calibrator.

5–53. KΩ Adjust R24 and R23 Selection (3036B only).

a. Push KΩ and 200 K range.

b. Set R24 to mid-range.

c. Connect a 190 KΩ standard resistor to the VΩ and COMMON binding posts.

d. Note that the displayed reading falls within the range of 189.50 and 190.50. If not in this nominal range select R23 until a reading of 189.75 and 190.25 is obtained with KΩ Adj. (R24) set to mid-range.

e. Adjust KΩ Adj. potentiometer R24 for a displayed reading of 190.00 ± 2 LSD.

f. Check all KΩ ranges as indicated for the 3036B in Table 5–3 and if not within specifications repeat steps 5–49 through 5–53.

g. Disconnect ohms calibration standards from KΩ and COMMON.

5–54. AC ZERO Adj. R82.

a. Push ACA and 2000 mA range.

b. Adjust AC zero Adj. potentiometer R82 to obtain a displayed reading of 0000.0 + 1 LSD.

5–55. 200 mV VAC Range Verification and R10 Selection.

a. Push ACV and 200 mV range.

b. Apply 190 mV rms at 500 Hz to the V–Ω and COMMON binding posts.

c. Note displayed reading of 188.80 to 191.20 for the 3036A and 189.52 to 190.48 for the 3036B.

d. If step c is not within range replace (or select) R10.

5–56. ÷ 10,000 Attenuator Adj. R5 (3036A only).

a. Push ACV and 20 V range.

b. Apply 19 V rms at 500 Hz to the V–Ω and COMMON binding post.

c. Adjust the ÷ 10,000 Attenuator Adj. (R5) to obtain a displayed reading of 19.000 ± 2 LSD.

5–57. 200 V HI Frequency Adj, C2.

a. Push ACV and 200 V range.

b. Apply 190 V rms at 500 Hz to V–Ω and COMMON.

c. Use an insulated alignment tool to adjust 200 V. Hi Frequency Adj. trimmer (C2) to obtain a reading of 190.000 ± 5 LSD.

NOTE

Enclosing the instrument with a grounded top cover will add capacity and slightly change the calibration setting of C2. Determine the displayed difference in reading with the cover properly installed and add this difference in reading to the adjustment of C2 in step c above.

5–58. mA Cal Adj. R17.

a. Connect DC current calibrator to the A and COMMON binding post. Set the current calibrator for minimum output prior to connecting to the DMM.

b. Push DCA and 2000 m range.

c. Apply +1.90 A dc.

d. Adjust the mA Cal Adj. wire tap R17 to obtain a display reading of +1.9000 ± 1 LSD. Adjustment is made by unsoldering the tapped wire and sliding it (while holding the soldering iron) until the reading is observed.

e. Disconnect the DC Current Calibrator.

f. An optional check for AC current accuracy connect on AC Current Calibrator to the A and COMMON binding posts. Apply 1.90 A rms at 500 Hz and check for a displayed reading of 1886.2 to 1993.8 on the 3036A and 1892.3 to 1907.7 on the 3036B.

5–59. TROUBLESHOOTING AND FAULT FINDING.

5–60. The troubleshooting procedures should only be performed when the instrument cannot be calibrated with the calibration procedures listed in paragraphs 5–31 through 5–58. Should the instrument be inoperative or out of specification, follow the fault finding procedures listed below.

5–61. Carefully examine the instrument and check for any visual evidence of trouble. Check for broken wires, burned resistors, loose components, shorts, or open or defective solder joints on the printed circuit board. Check for separation of printed circuit board lands and pads. Check for open, defective, or intermittent switches. Check that connectors are clean and will mate properly. Check that instrument circuit ground is properly connected to the metal coating shield on the plastic case top, bottom and side supports. Check that the power line earth ground is connected only to the front and rear panels. Troubleshoot with COMMON connected to power line earth ground.

5–62. Understand and be familiar with the circuit theory of Section 4. Use the functional block diagram of Figure 4–1 and the schematic diagram to isolate the probable circuit areas which may cause the problem. Always check the power supply voltages. Check for oscillations in the circuitry by using an oscilloscope. Then refer to the fault finding and troubleshooting hints for that circuit. Table 5–8 gives some probable corrections for specific symptoms.

Note

All tests and calibration procedures listed herein consider the normal service conditions of 15°C to +35°C. Calibrate the instrument with the ambient temperature at 22°C to 25°C. Always cover top of open instrument to simulate inside case temperature conditions when making adjustments.

5–63. FUSE REPLACEMENT.

5–64. The ac power line fuse F50 is located on the inside of the rear panel. To replace the fuse, remove the covers as described in paragraph 5–33, remove the defective fuse, and snap in the replacement fuse.

5–65. PREVENTIVE MAINTENANCE.

5–66. Cleaning. The instrument should be cleaned as often as operating conditions require. Thoroughly clean both the inside and outside of the instrument. Remove dust from inaccessible areas with low pressure compressed air or vacuum cleaner. Use alcohol applied with a cleaning brush to remove accumulations of dirt or grease from connector contacts and component terminals. Clean the exterior of the instrument and the front panel with a mild detergent mixed with water, applying the solution with a soft, lint-free cloth.

5–67. Repair and Replacement. Repair and replacement of electrical and mechanical parts must be accomplished with care and caution. Printed circuit component boards can become warped, cracked, or burnt from excessive heat or mechanical stress. The following repair techniques are suggested to avoid inadvertent destruction or degradation of parts and assemblies.

a. Use a low-heat capacity soldering iron (Weller Model No. W-TCP 35 watt) with a 700°F tip 1.5 mm (1/16") to 2.5 mm (3/32") wide.

b. Be sure that the soldering iron tip and the cabinet and COMMON connectors are securely tied to "earth" ground. This avoids possible overvoltage damage to semiconductors and capacitors.

c. To desolder components, use a commercial "solder sipper," (SOLDA PULLT manufactured by Edsyn Products or equivalent) or use solder-removing SODER-WICK, size 3, manufactured by SOLDER REMOVAL CO., Covina, California.

d. To remove a component, clip a heat sink such as long nose pliers, tweezers, or alligator clips onto the component lead and as close to the body of the component as possible.

This assures minimum heating of the component while soldering.

Place the soldering iron directly on the component lead on the printed circuit conductor side of the board. Use a de-soldering aid to remove all solder and free the component lead.

5–66. REPLACING PUSHBUTTON SWITCHES.

a. Pushbutton switches may be disassembled for replacement of worn switch wipes and return springs. This saves unsoldering the multicontact switch. New parts must be taken from replacement switch assemblies which may be ordered as spare parts. To obtain access to pushbutton switches remove front panel and pushbuttons. Remove the retainer. Carefully slide the switch bar out the rear of the switch. Access is then obtained to the individual switch contact sliding springs. Clean the switch and lubricate contacts.* Place the new contact springs into the switch bar and carefully reassemble the switch bar through the rear of the switch assembly. To simplify assembly reinsert two switch contact slider springs at a time. When all contact slider springs are in place and the push bar is fully extended out the front of the housing, replace the detent.

Operate the rebuilt switch several times to be sure all parts are in place. Then reassemble and test the instrument.

b. It is recommended that all contact slider springs be replaced in all switches. If the entire switch assemblies are to be replaced, use a solder pot or solder wave (rather than soldering iron and solder sucker) to remove the switch assemblies.

c. Do not clean switch with Freon or other solvents. Periodically lubricate all switch contacts with a light application of spray lubricant.*

*Use switch contact lubricant and cleaner such as Electrolube Contact Treatment Oil 2AX or Centralab Switch Contact Spray Lubricant, Ballantine P/N 80100090A.

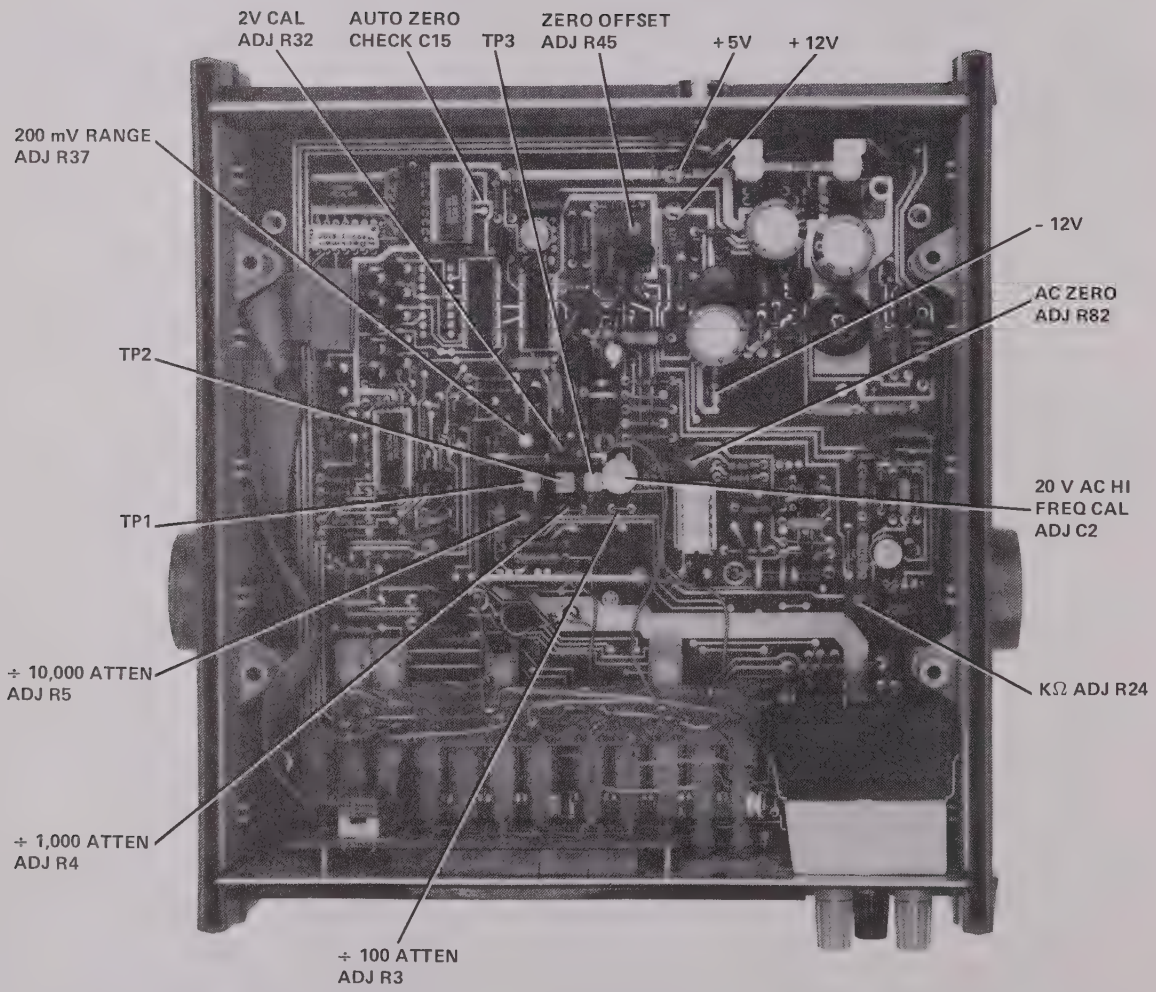
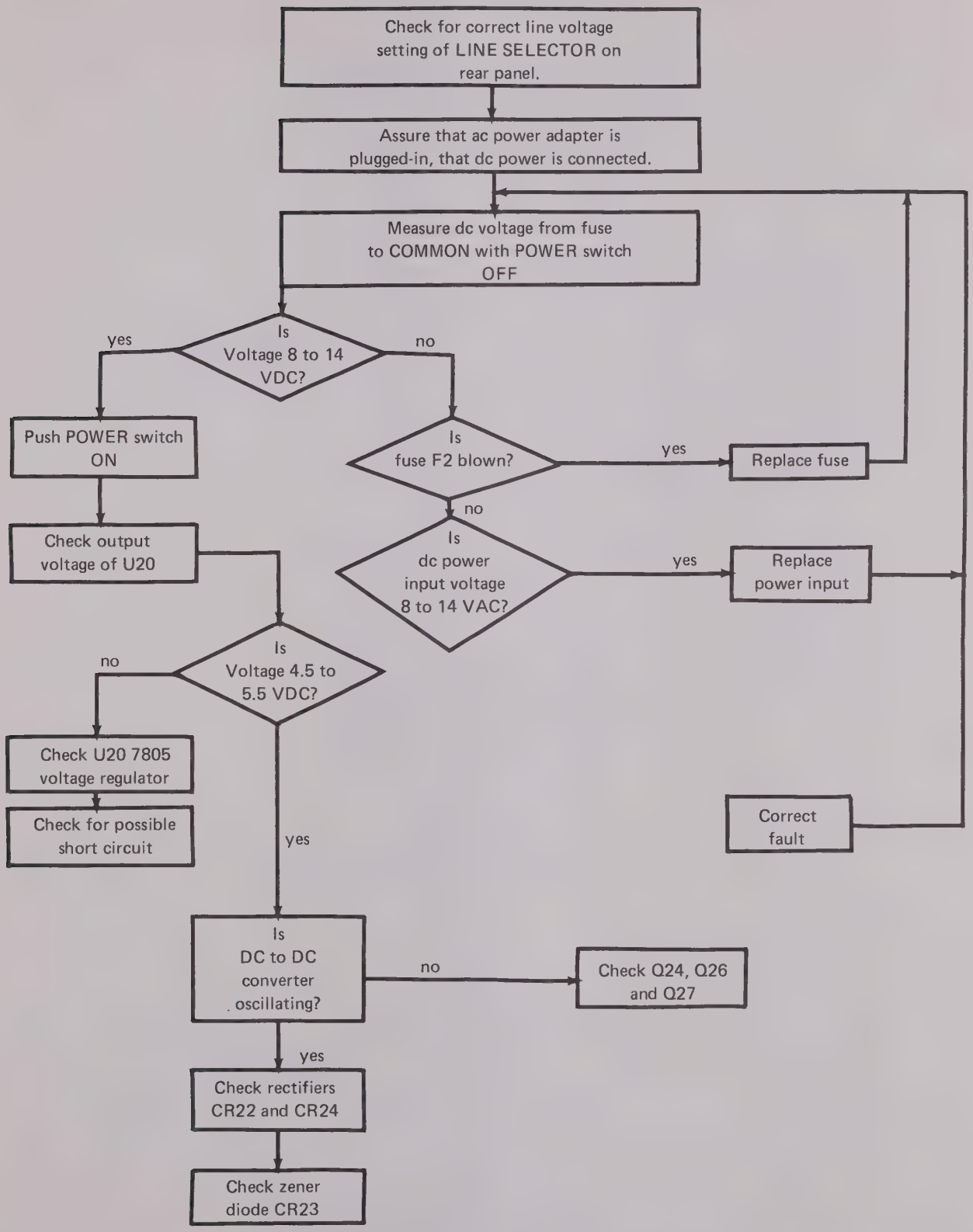
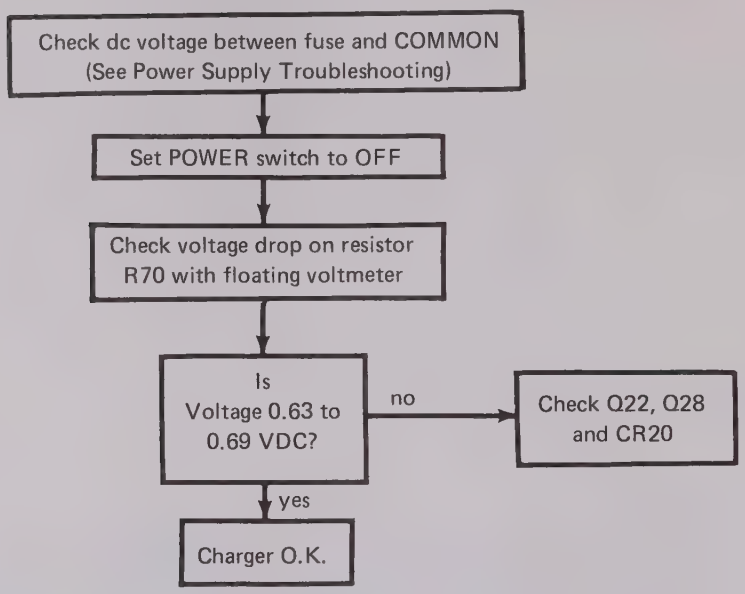


Figure 5–1. Location of Internal Adjustments and Test Points

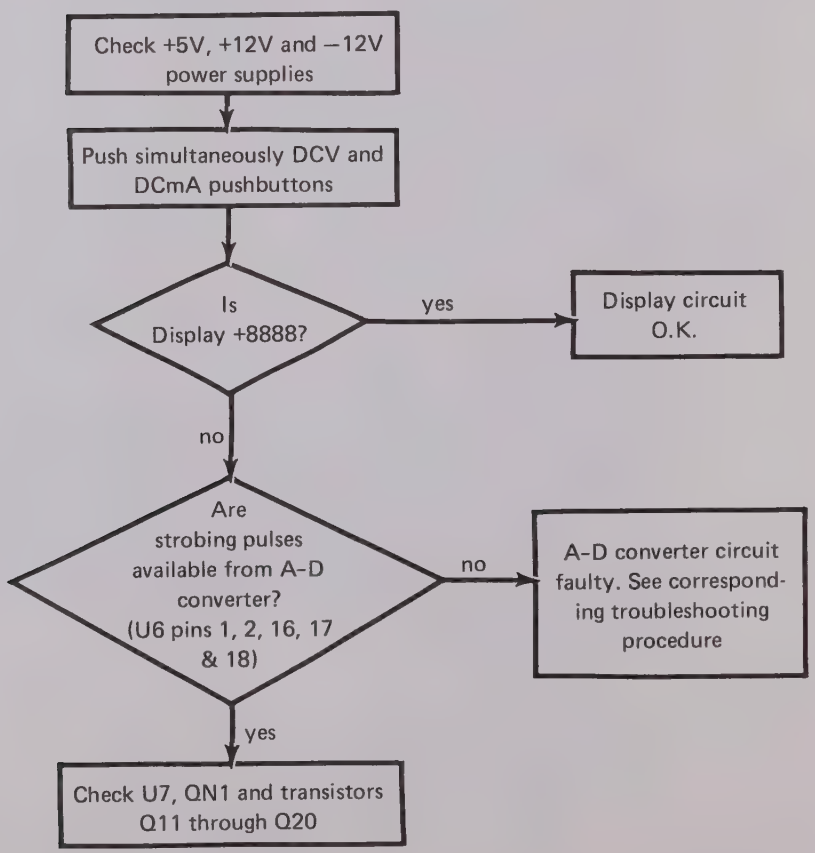
POWER SUPPLY TROUBLESHOOTING


Check for correct line voltage setting of LINE SELECTOR on rear panel.
Assure that ac power adapter is plugged-in, that dc power is connected.
Measure dc voltage from fuse to COMMON with POWER switch OFF
Is Voltage 8 to 14 VDC?
yes
no
Push POWER switch ON
Check output voltage of U20
Is fuse F2 blown?
yes
Replace fuse
no
Is dc power input voltage 8 to 14 VAC?
yes
Replace power input
Is Voltage 4.5 to 5.5 VDC?
no
Check U20 7805 voltage regulator
Check for possible short circuit
Correct fault
yes
Is DC to DC converter oscillating?
no
Check Q24, Q26 and Q27
yes
Check rectifiers CR22 and CR24
Check zener diode CR23

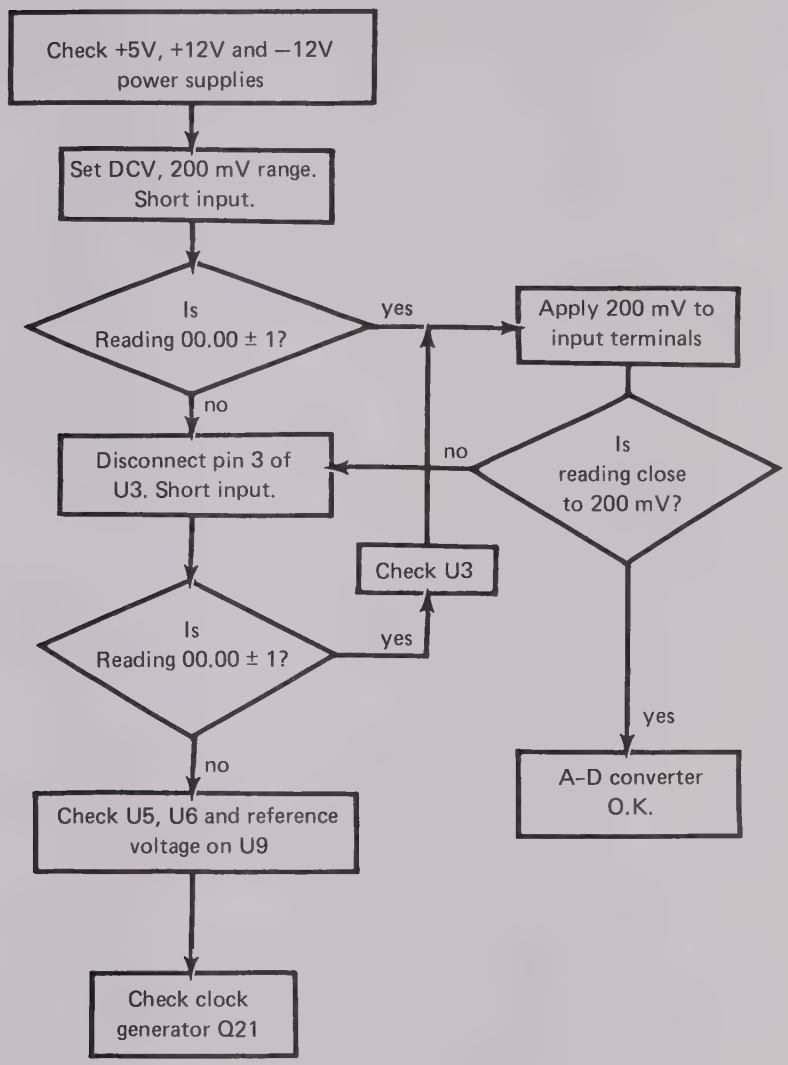
BATTERY CHARGER CHECK AND TROUBLESHOOTING


Check dc voltage between fuse and COMMON (See Power Supply Troubleshooting)
Set POWER switch to OFF
Check voltage drop on resistor R70 with floating voltmeter
Is Voltage 0.63 to 0.69 VDC?
no
Check Q22, Q28 and CR20
yes
Charger O.K.

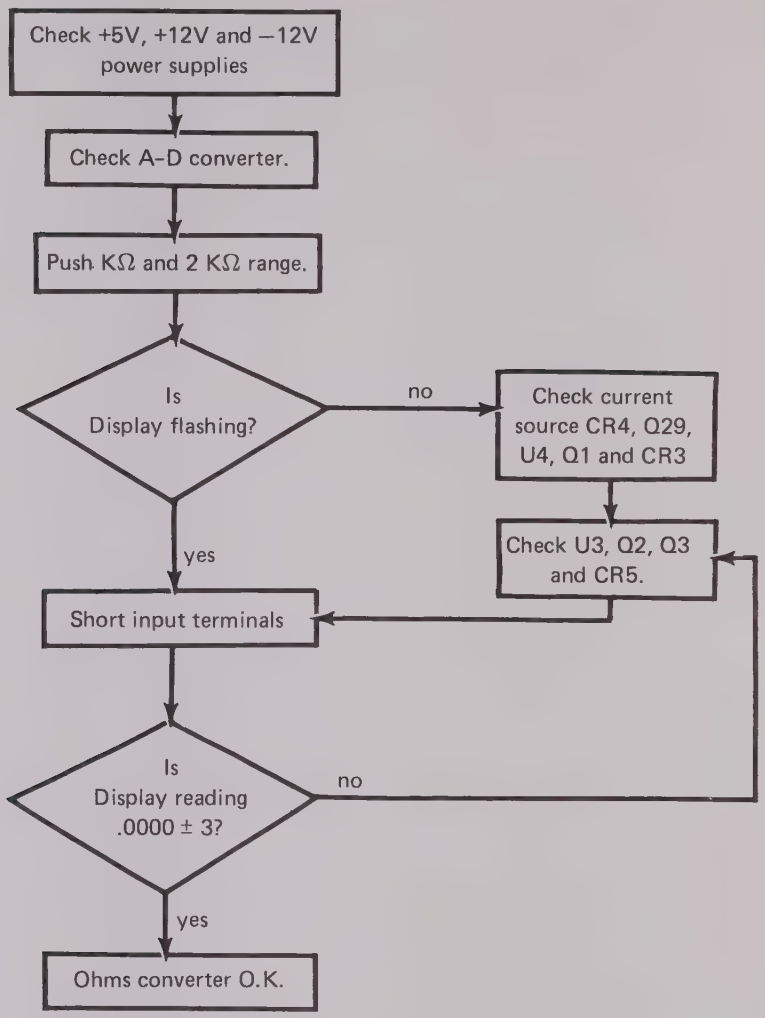
DISPLAY CIRCUIT CHECK AND TROUBLESHOOTING


Check +5V, +12V and −12V power supplies
Push simultaneously DCV and DCmA pushbuttons
Is Display +8888?
yes
Display circuit O.K.
no
Are strobing pulses available from A-D converter? (U6 pins 1, 2, 16, 17 & 18)
no
A-D converter circuit faulty. See corresponding troubleshooting procedure
yes
Check U7, QN1 and transistors Q11 through Q20

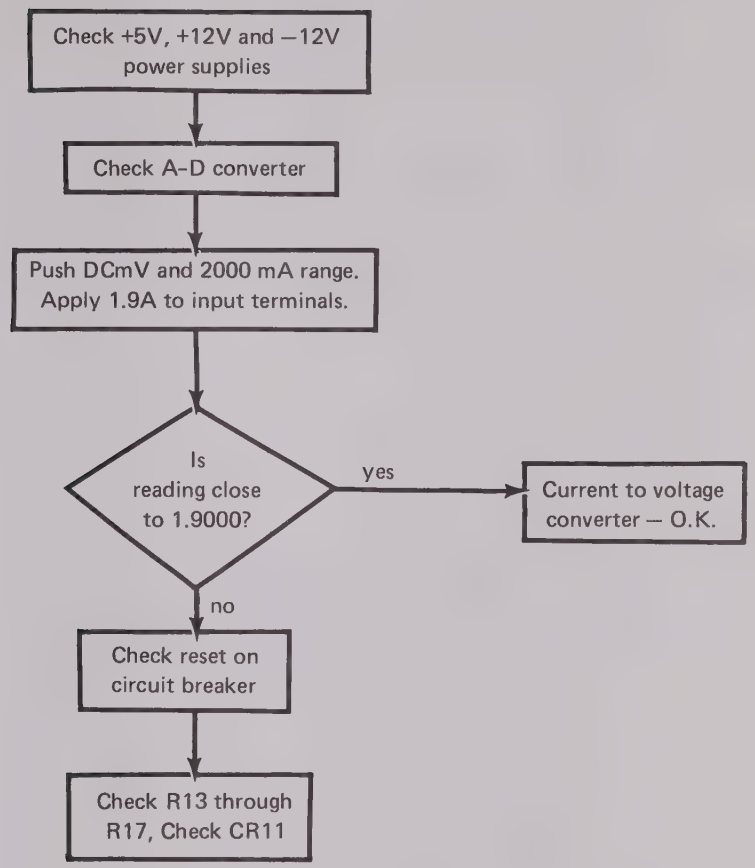
A TO D CONVERTER CHECK AND TROUBLESHOOTING



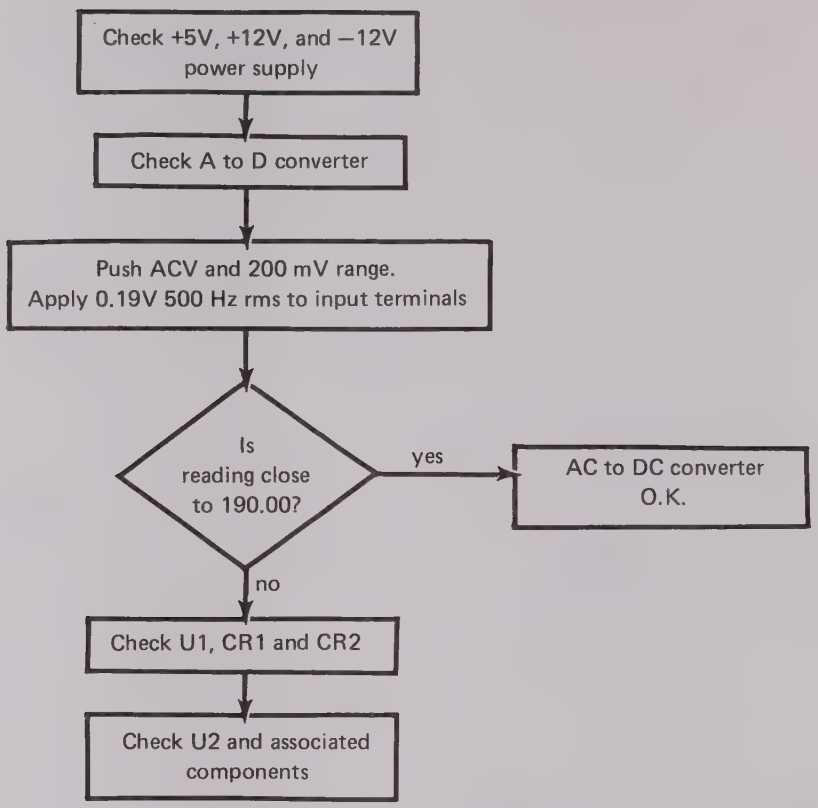
OHMS CONVERTER CHECK AND TROUBLESHOOTING



CURRENT TO VOLTAGE CONVERTER CHECK AND TROUBLESHOOTING


Check +5V, +12V and −12V power supplies
Check A-D converter
Push DCmV and 2000 mA range. Apply 1.9A to input terminals.
Is reading close to 1.9000?
yes
Current to voltage converter — O.K.
no
Check reset on circuit breaker
Check R13 through R17, Check CR11

AC TO DC TRUE RMS CONVERTER
CHECK AND TROUBLESHOOTING


Check +5V, +12V, and −12V power supply
Check A to D converter
Push ACV and 200 mV range. Apply 0.19V 500 Hz rms to input terminals
Is reading close to 190.00?
yes
AC to DC converter O.K.
no
Check U1, CR1 and CR2
Check U2 and associated components

PERFORMANCE TEST RECORDS

BALLANTINE MODEL 3036A, OPTION _____ SERIAL NUMBER _____

1.	DC Power Input Check		_____ (✓)
2.	Display Test	(888)	_____ (✓)
3.	Hi/Lo Line Check	(0.00±3 LSD)	_____ (✓)
4.	AC Converter Check		_____ (✓)
5.	Battery Test (Option 05 installed)	(>5 volts display reading)	_____ (✓)

6. DC Voltage Calibration Check

DC Voltage Standard	Range Switch Setting	Readout Limits		Reading
		Minimum	Maximum	
0.0000 (Short)	200 mV	± 00.00	± 00.03	
±0.0100	200 mV	± 00.98	± 01.02	
±0.1000	200 mV	± 99.94	±100.07	
±0.1900	200 mV	± 189.87	±190.13	
0.0000 (Short)	2 V	± .0000	± .0002	
±1.0000	2 V	± .9994	±1.0007	
±1.9000	2 V	±1.8987	±1.9013	
+10.000	20 V	± 9.994	±10.007	
+19.000	20 V	±18.987	±19.013	
+100.00	200 V	± 99.94	±100.07	
+190.00	200 V	±189.87	±190.13	
+ 500.0	1200 V	± 499.6	± 500.4	
+1000.0	1200 V	± 999.4	±1000.7	

7. DC Current Calibration Check

DC Current Calibrator (milliamps)	Range Switch Setting	Reading Limits		Reading
		Minimum	Maximum,	
0.0000	200 μA	± 00.00	± 00.03	
±0.1900	200 μA	±189.59	±190.41	
±1.9000	2 mA	±1.8959	±1.9041	
±19.000	20 mA	±18.959	±19.041	
±190.00	200 mA	±189.59	±190.41	
±1900.0	2000 mA	±1895.9	±1904.1	

8. AC Voltage Calibration Check

(COMMON tied to earth ground lug on rear panel)

AC Voltage Calibrator		DMM			
		Display Limits			
Voltage	Frequency	Range	Low Limit	High Limit	Reading
0000 (Short)	500 Hz	200 m	00.00	00.05	
100.00 mV	500 Hz	200 m	99.40	100.60	
190 mV	500 Hz	200 m	188.80	191.20	
190 mV	20 kHz	200 m	188.80	191.20	
1.900 V	30 Hz	2	1.8805	1.9195	
1.900 V	500 Hz	2	1.8880	1.9120	
1.900 V	20 kHz	2	1.8880	1.9120	
19.00 V	500 Hz	20	18.880	19.120	
19.00 V	20 kHz	20	18.880	19.120	
190.0 V	500 Hz	200	188.80	191.20	
190.0 V	20 kHz	200	188.80	191.20	
750.0 V	500 Hz	1200	745.0	755.0	
750.0 V	10 kHz	1200	741.4	758.5	

9. Ohms Calibration Check

Resistance Standard	DMM			
	Display Limits			
	Range	Low	High	Reading
0000	200			
190.00	200	189.78	190.22	
1.9000 k	2 K	1.8978	1.9022	
19.000 k	20 K	18.978	19.022	
190.00 k	200 K	189.78	190.22	
1.900 M	2000 K	1897.8	1902.2	
19.00 M	20 M	18.959	19.041	

10. 1 kV COMMON to CASE Test (operation only) _____ (✓)

11. Options Check; Option _____ Option _____ Option _____ _____ (✓)

12. Mechanical Check _____ (✓)

_____ _____

Signature *Date*

SECTION 6

REPLACEABLE PARTS LIST AND CIRCUIT SCHEMATIC DIAGRAMS

The replacement parts listed are available from the vendors listed or from Ballantine Laboratories. Your local Ballantine Field Engineering Representative may also carry a stock of parts and can assist you. If pricing quotations are required for parts and or repairs your local representative will give the most rapid service or you may contact the Ballantine Factory directly.

When ordering replacement parts always give the following information:

a) Instrument Model number
b) Serial number
c) Ballantine Part number
d) Schematic Symbol number
e) Identification and description of the part

Ballantine will do its best to improve the instrument and make changes in style of components and replacement parts. Replacement parts may differ in appearance from those found in your instrument but are always equal or superior in performance. Where necessary minor mechanical modifications may be required in the replacement of the components.

Parts are generally available locally for most replacements. The parts list calls out the recommended vendors where applicable.

The instrument may substitute alternate components but the use of parts specified in this parts list is recommended. A part similar to the part initially installed at the factory may be used, i.e., a 5% composition resistor may be replaced with a similar part or a 5% film resistor or the preferred 1% metal film resistor. Use of the preferred component will always simplify calibration and speed repairs.

Any selected component is generally identified in this manual and may be replaced with a similarly valued part unless reselection is required due to replacement or change of its related part. The schematics and calibration procedures identify selected components and replacement procedures.

The Manufacturer Code is taken from Federal Supply Code Cataloging Handbooks H4-1, H4-2, and H4-3. Ballantine Code is 50423.

The following parts coding are used:

CVC	Capacitor, Variable, Ceramic
CCT	Capacitor, Ceramic, Tubular
CFP	Capacitor, Fixed, Plastic
CCD	Capacitor, Ceramic, Disc
CYF	Capacitor, Mylar, Foil
CMD	Capacitor, Mica, Dipped
CMM	Capacitor, Mica, Molded
CEA	Capacitor, Electrolytic, Aluminum
CET	Capacitor, Electrolytic, Tantalum
DGP	Diode, General Purpose
DZG	Diode, Zener, General Purpose
DRP	Diode, Bridge, Power
FLT	Filter
ICP	Integrated Circuit
TRQ	Transistor
RFF	Resistor, Fixed, Film
RFC	Resistor, Fixed, Composition
RVC	Resistor, Variable, Composition
RFW	Resistor, Fixed, Wirewound
SWC	Switch
LMP	Lamp
TRX	Transformer

Resistors may generally be replaced by Corning Electronics (CCW) type N-55, N-60 and C-32. Allen Bradley carbon composition resistors type EB may also be used but should generally be avoided (except for emergency replacements) in favor of the preferred part listed in this parts list.

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C..1	07-10484-0A	CYF 68.0NF 1.0KV =-20%	50423	
C..2	07-10268-0A	CVG 5-18PF 1.0 KV GLASS TR	50423	
C..3	07-10053-0A	CET 10.0UF 35.0V M	56289	SPRAGUE 1960106X0035A3
C..4	07-09550-0A	CCD 100 NF 12 V M 20%	72982	REFER TO 07-09589-0A
C..5	07-09581-0A	CET 2.2UF 35 V K 10%	50423	
C..6	07-10087-0A	CMD 390.0PF 100 VIJ	84171	ARCO TYPE RDM15-391J
C..7	07-02540-0A	CCD 5.0NF 100.0 V +-20%	4171	ARCO #T CPR005 OR EQUAL
C..8	07-10293-0A	CBM 33.0NF 100.0 VJ	50587	PLESSEY 161 SER MINIBOX
C..9	07-10340-0A	CBM 22.0NF 400.0 V +-10%	80031	MEPCO C280MCF/A22K
C.10	07-10354-0A	CMD 1.0NF 500.0 V +- 1%	84171	ARCO DM-19-E-D-1000-F-N-U
C.11	07-10301-0A	CBM 680.0NF 63.0 VJ	50587	PLESSEY 161 SER MINIBOX
C.12	07-10103-0A	CMD 250.0PF 500 V +-5%	84171	ELMENCO DM1525J
C.13	07-09564-0A	CCD 5 NF 1 KV M 20%	56289	SPG TYP 5G1-D50
C.14	07-09571-0A	CCD 50 NF 50 V	71590	CTL TYP CK503
C.15	07-10117-0A	CMD 12.0PF 500.0 VJ	84171	ELMENCO DM15C120JN
C.16	07-10053-0A	CET 10.0UF 35.0V M	56289	SPRAGUE 1960106X0035A3
C.17	07-10053-0A	CET 10.0UF 35.0V M	56289	SPRAGUE 1960106X0035A3
C.18	07-09550-0A	CCD 100 NF 12 V M 20%	72982	REFER TO 07-09589-0A
C.19	07-10418-0A	CMD 750.0PF300.0 VJ	53201	SANGAMO CM05E0751J03, EQ
C.20	07-10447-0A	CEA2200.0UF 16.0 V	50423	
C.21	07-10447-0A	CEA2200.0UF 16.0 V	50423	
C.22	07-10418-0A	CMD 750.0PF300.0 VJ	53201	SANGAMO CM05E0751J03, EQ
C.23	07-10009-0A	CCD 2.2NF 500 V DISC	73345	AMPEREX C0238501E222P
C.24	07-10093-0A	CEA 100.0UF 16 V UPPC MNT	0	STET-TRUSH ERO EK100/16
C.25	07-10092-0A	CEA 470.0UF 35. V	0	STET-TRUSH ERO EGK470/35
C.27	07-10012-0A	CMD 100.0PF 100 V J DIPMICA	84171	ARCO TYPE RDM15-101J
C 28	07-10183-0A	CET 47.0 UF 20.0 VM DIP TAN	56289	SPRAGUE 196D476X0020-LA3
CR.1	05-09468-0A	DGP FD300 150 175M .4	7263	FCH SI D07
CR.2	05-09468-0A	DGP FD300 150 175M .4	7263	FCH SI D07
CR.3	05-09481-0A	DGP 1N4005 600 1A	4713	MOT SI D041
CR.4	05-10110-0A	DZG 1N4571 6.2V 1MA	4713	MOT 1N4571
CR.5	05-09481-0A	DGP 1N4005 600 1A	4713	MOT SI D041
CR10	05-10026-0A	DGP 1N4151 75 50M	24446	GE SI D035 4 2
CR11	05-09469-0A	DGP MDA920A-2 50 1A	4713	MOT BRIDGE REC
CR12	05-10026-0A	DGP 1N4151 75 50M	24446	GE SI D035 4 2
CR22	05-10071-0A	DGP 1N4934 100 1A	7263	FCH SI 200
CR23	05-10066-0A	DZG 1N 759 12 20M	4713	MOT SI
CR24	05-10071-0A	DGP 1N4934 100 1A	7263	FCH SI 200
CR25	05-09481-0A	DGP 1N4005 600 1A	4713	MOT SI D041
L..1	03-10056-0A	CIL .33MH INDUCTOR	83125	NYTRONICS WEE330
Q..1	10-10143-0A	TRQ NSD135 NPN BVCB 350V	27014	NATIONAL NSD135
Q..2	10-10035-0A	TRQ 2N4126 PNP 25 PTO-92	4713	MOT 1 250M 60
Q..3	10-10144-0A	TRQ 2N5416PNP BVCB 300V	4173	MOTOROLA
Q..4	10-10130-0A	TRQ E108 N J FET TO-106	17856	SILICONIX E108 A0S=BOHMS
Q..5	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q..6	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q..7	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q..8	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q..9	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.10	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.11	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.12	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.13	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.14	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.15	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q.16	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q.17	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q.18	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q.19	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q.20	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q.21	10-10145-0A	TRQ E211 JFET N CHANNAL	50423	
Q.24	10-09457-0A	TRQ 2N4918 PNP 1 40 P	4713	30 3M 20
Q.26	10-10034-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
Q.27	10-10034-0A	TRQ 2N4124 NPN 1 25 PT0-92	4713	MOT 1 300M 50
Q.29	10-10143-0A	TRQ NSD135 NPN BVCB 350V	27014	NATIONAL NSD135
QN.1	10-10133-0A	TRQ CA3081 NPN 7 16V S16DIP	86684	RCA 0.5W 70
R..1	12-12572-0A	RFF 562.0 K 500.0MW F+- 1%	16299	CGW RN60D 5623 F
R..5	09-10004-0A	RVF 100.0 0.5 W M	73138	HEL TYP 72PM
R..6	12-13124-0A	RFF 8.95K 500.0MW B	16299	CGW RN60E 25PPM
R..8	12-13125-0A	RFF 1.0 K 500.0MW B	16299	CGW RN60E 25PPM
R..9	12-01263-0A	RFC 47.0 K 1.0 W K+-10%	1121	A-B TYP GB
R.10	12-13126-0A	RFF 9.0 K 500.0MW B	16299	CGW RN60E 25PPM
R.11	12-13125-0A	RFF 1.0 K 500.0MW B	16299	CGW RN60E 25PPM
R.12	12-06107-0A	RCF 10.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.13	12-12835-0A	RFW 900.0 2.0 W 0.1%	91637	DALE RS-2C OR EQUIV
R.14	12-12836-0A	RFW 90.0 2.0 W 0.1%	91637	DALE RS-2C OR EQUIV
R.15	12-12837-0A	RFW 9.0 2.0 W 0.1%	91637	DALE RS-2C OR EQUIV
R.16	12-12838-0A	RFW 0.9 2.0 W 0.1%	91637	DALE RS-2C OR EQUIV
R 13*	12-13201-0A	RFW 900.0 2.0 W 0.5%	91637	DALE RS-2C OR EQUIV
R 14*	12-13202-0A	RFW 90.0 2.0 W 0.5%	91637	DALE RS-2C OR EQUIV
R 15*	12-13203-0A	RFW 9.0 2.0 W 0.5%	91637	DALE RS-2C OR EQUIV
R 16*	12-13204-0A	RFW 0.9 2.0 W 0.5%	91637	DALE RS-2C OR EQUIV
R.17	12-12839-0A	RVW 0.1 SLIDE TAP ADJUST	50423	
R.19	12-08040-0A	RFC 470.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.20	12-08042-0A	RFC 270.0 250.0MW J+- 5%	1121	A-B TYP CB
R.21	12-08023-0A	RFC 2.2 K 250.0MW J+- 5%	1121	A-B TYP CB
R.22	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R.23	12-12378-0A	RFF 6.49K 250.0MW F+- 1%	16299	CGW RN55D 6491 F
R.24	09-10107-0A	RVF 200.0 250.0MW K CER	73138	HEL TYPE 72PM-200
R.26	12-12862-0A	RFC 560.0 K 2.0 W 5%	1121	A-B HB
R.27	12-08040-0A	RFC 470.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.28	12-08042-0A	RFC 270.0 250.0MW J+- 5%	1121	A-B TYP CB
R.31	12-13127-0A	RFF 75.0 K 500.0MW B	16299	CGW RN60E 25PPM
R.32	09-10201-0A	RVF 2.0 K+-20% 500.0MW	73138	HELIPOT 72XW2K
R.33	12-12476-0A	RFF 61.9 K 250.0MW F+- 1%	16299	CGW RN55D 6192 F
R.34	12-12464-0A	RFF 46.4 K 250.0MW F+- 1%	16299	CGW RN55D 4642 F
R.35	12-13128-0A	RFF 100.0 K 500.0MW B	16299	CGW RN60E 25PPM
R.36	12-13129-0A	RFF 10.9 K 500.0MW B	16299	CGW RN60E 25PPM
R.37	09-10107-0A	RVF 200.0 250.0MW K CER	73138	HEL TYPE 72PM-200
R.38	12-08029-0A	RFC 1.0 M 250.0MW J+- 5%	1121	A-B TYP CB
R.39	12-08029-0A	RFC 1.0 M 250.0MW J+- 5%	1121	A-B TYP CB
R.40	12-06107-0A	RCF 10.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.41	12-06107-0A	RCF 10.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.42	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R.43	12-01224-0A	RFC 2.7 250.0MW K+-10%	1121	A-B TYP CB
R.44	12-12572-0A	RFF 562.0 K 500.0MW F+- 1%	16299	CGW RN60D 5623 F
R.45	09-10134-0A	RVF 50.0 K 0.5 W +-30%	73138	HELIPOT 72PM
R.46	12-08016-0A	RFC 1.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.47	12-09804-0A	RFC 110.0 250.0MW J+- 5%	1121	A-B TYP CB
R.49	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.50	12-08010-0A	RFC 68.0 250.0MW J+- 5%	1121	A-B TYP CB
R.51	12-08010-0A	RFC 68.0 250.0MW J+- 5%	1121	A-B TYP CB
R.52	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.53	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.54	12-01085-0A	RFC 120.0 K 500.0MW J+- 5%	1121	A-B TYP EB
R.55	12-08023-0A	RFC 2.2 K 250.0MW J+- 5%	1121	A-B TYP CB
R.56	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.57	12-12272-0A	RFF 562.0 250 MW F+-1%	16299	CGW RN55D 5620 F
R.58	12-09804-0A	RFC 110.0 250.0MW J+- 5%	1121	A-B TYP CB
R.59	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.60	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.63	12-08019-0A	RFC 47.0 250.0MW J+- 5%	1121	A-B TYP CB

*Used on 3036B only.

PARTS LIST 3036A/B

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R.64	12-08954-0A	RFC 6.8 K 500.0MW J+- 5%	1121	A-B TYP EB
R.65	09-10195-1A	RVC 5.0. K +-30% LIN SHF 1/8	11236	CTS XBE200 50K +- 30%
R.66	12-08014-0A	RFC 47.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.67	12-08014-0A	RFC 47.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.79	12-01048-0A	RFC 4.7 K 500.0MW J+- 5%	1121	A-B TYP EB
R.80	12-01224-0A	RFC 2.7 250.0MW K+-10%	1121	A-B TYP CB
R.81	12-08014-0A	RFC 47.0 K 250.0MW J+- 5%	1121	A-B TYP CB
R.82	09-10134-0A	RVF 50.0 K 0.5 W +-30%	73138	HELIPOT 72PM
R 84 *	09-10116-0A	100.0 K	73138	HELIPOT 72 PM
R 85 *	09-10124-0A	10.0K	73138	HELIPOT 72 PM
R 86 *	09-10006-0A	1.0K	73138	HELIPOT 72 PM
R 87 *	12-12128-0A	19.6Ω	73138	CGW RN55D
RN.1	13-10006-0A	RNF 2.0 K 250.0MW B7RESDIP	80053	BECKMAN 899-3-R 2.0K
RN.2	13-10044-0A	RNF 100.0 14 1.5W 14DIP 7R	80053	BECKMAN 899-3-R100
RN.3	13-10075-0A	RNF 3036 ATTENUATOR .04%MATC	0	CADDOCK 1776-101
S..0	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..1	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..2	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..3	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..4	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..5	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..6	25-40181-0A	SWC 3036A RANGE SWITCH	50423	
S..7	25-40182-0A	SWC 3036A FUNCTION SWITCH	50423	
S..8	25-40182-0A	SWC 3036A FUNCTION SWITCH	50423	
S..9	25-40182-0A	SWC 3036A FUNCTION SWITCH	50423	
S.10	25-40182-0A	SWC 3036A FUNCTION SWITCH	50423	
S.11	25-40182-0A	SWC 3036A FUNCTION SWITCH	50423	
T..2	20-40062-0A	TRX 3036A DC/DC CONVERTER	50423	
U..1	24-10212-0A	ICP CA3140E FET OP AM MINDIP	86684	RCA CA3140S TO-5 CU.JN.LN
U..2	24-10251-0A	ICP AD536J TRUE RMS-DC CONN	24355	ANALOG DEVICES AD536J
U..3	24-10212-0A	ICP CA3140E FET OP AM MINDIP	86684	RCA CA3140S TO-5 CU.JN.LN
U..4	24-10212-0A	ICP CA3140E FET OP AM MINDIP	86684	RCA CA3140S TO-5 CU.JN.LN
U..5	24-10210-1A	ICP LD120CJ MOD DVM .005%	50423	
U..6	24-10211-1A	ICP LD121CJ MOD DIG 4 1/2	86664	SILICONIX-ANALOG
U..7	24-10109-0A	ICP MC14511 7 SEGMENT DRIVE	2413	MORTOROLA OR EQUV
U..8	24-10255-0A	ICP MC14512 MULTIPLEXER	4713	MOTOROLA MC14512
U..9	24-10256-0A	ICP REF-02C 25PPM VOLT REF.	0	PMI REF-02C
U 9*	24-10285-0A	ICP REF-02H 10 PPM VOLT REF		PMI REF-02H
U.20	24-10001-0A	TCD UA7805	7263	FAIRCHILD

PARTS LIST 3036A/B FRONT PANEL

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
DS.1	21-10046-0A	UBD 0.43 IN HI-EFF RED C.A.0	28480	HP 5082-7650
DS.2	21-10046-0A	UBD 0.43 IN HI-EFF RED C.A.0	28480	HP 5082-7650
DS.3	21-10046-0A	UBD 0.43 IN HI-EFF RED C.A.0	28480	HP 5082-7650
DS.4	21-10046-0A	UBD 0.43 IN HI-EFF RED C.A.0	28480	HP 5082-7650
DS.5	21-10041-0A	IND 0.43 IN.HIEF.RED CC +-1	28480	HP 5082-7656 COMMON CAT.
J..1	31-10132-0A	BPS 10MM GREY	50423	
J..2	31-10132-0A	BPS 10MM GREY	50423	
J..4	31-10133-0A	BPS 10MM BLACK'	50423	

* Used on 3036B only.

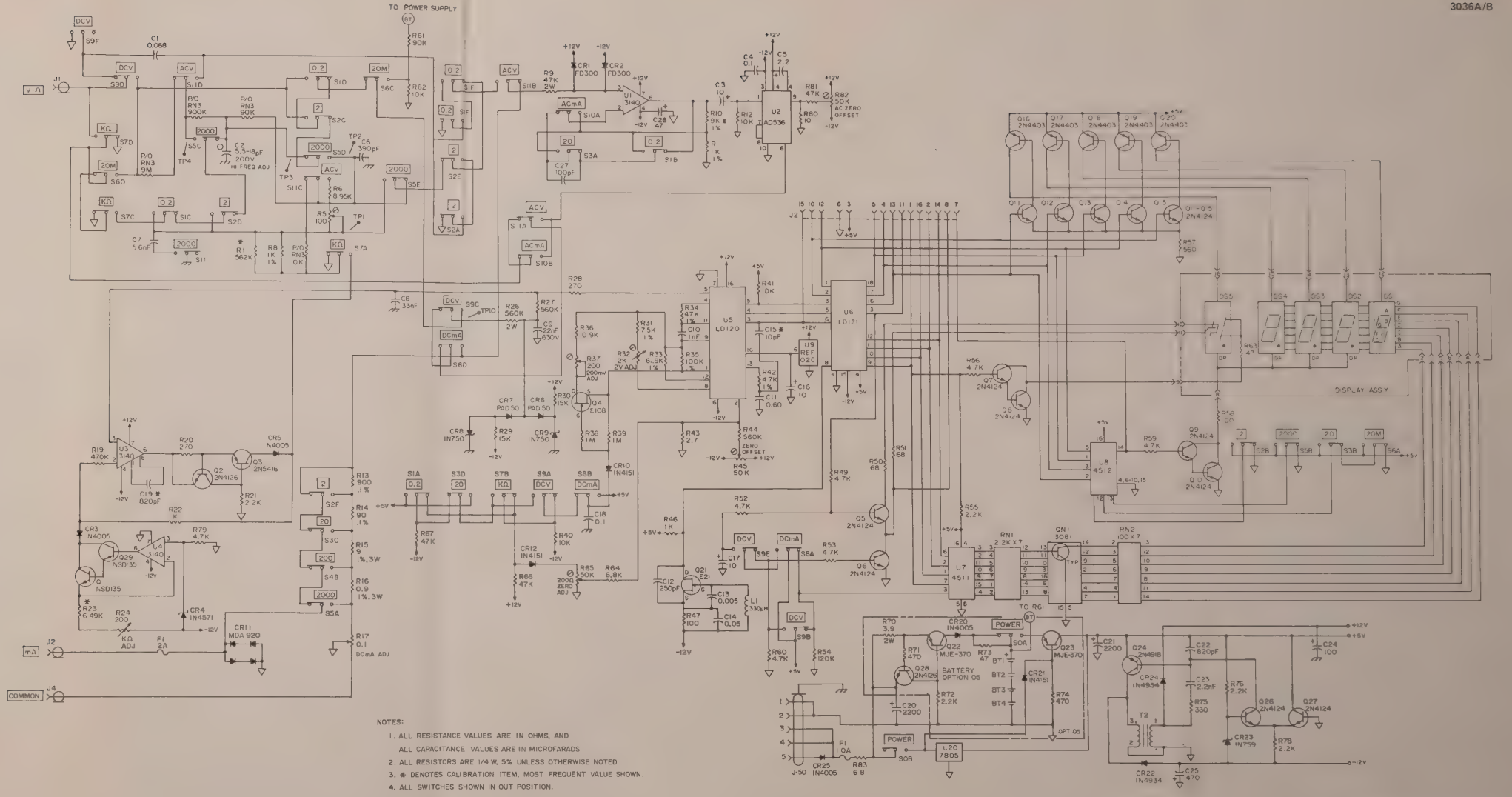

TO POWER SUPPLY
DISPLAY ASSY
POWER
BATTERY OPTION 05
OPT 05
NOTES:
1. ALL RESISTANCE VALUES ARE IN OHMS, AND
ALL CAPACITANCE VALUES ARE IN MICROFARADS
2. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED
3. * DENOTES CALIBRATION ITEM, MOST FREQUENT VALUE SHOWN.
4. ALL SWITCHES SHOWN IN OUT POSITION.

Figure 6–1. Model 3036A, Schematic Diagram

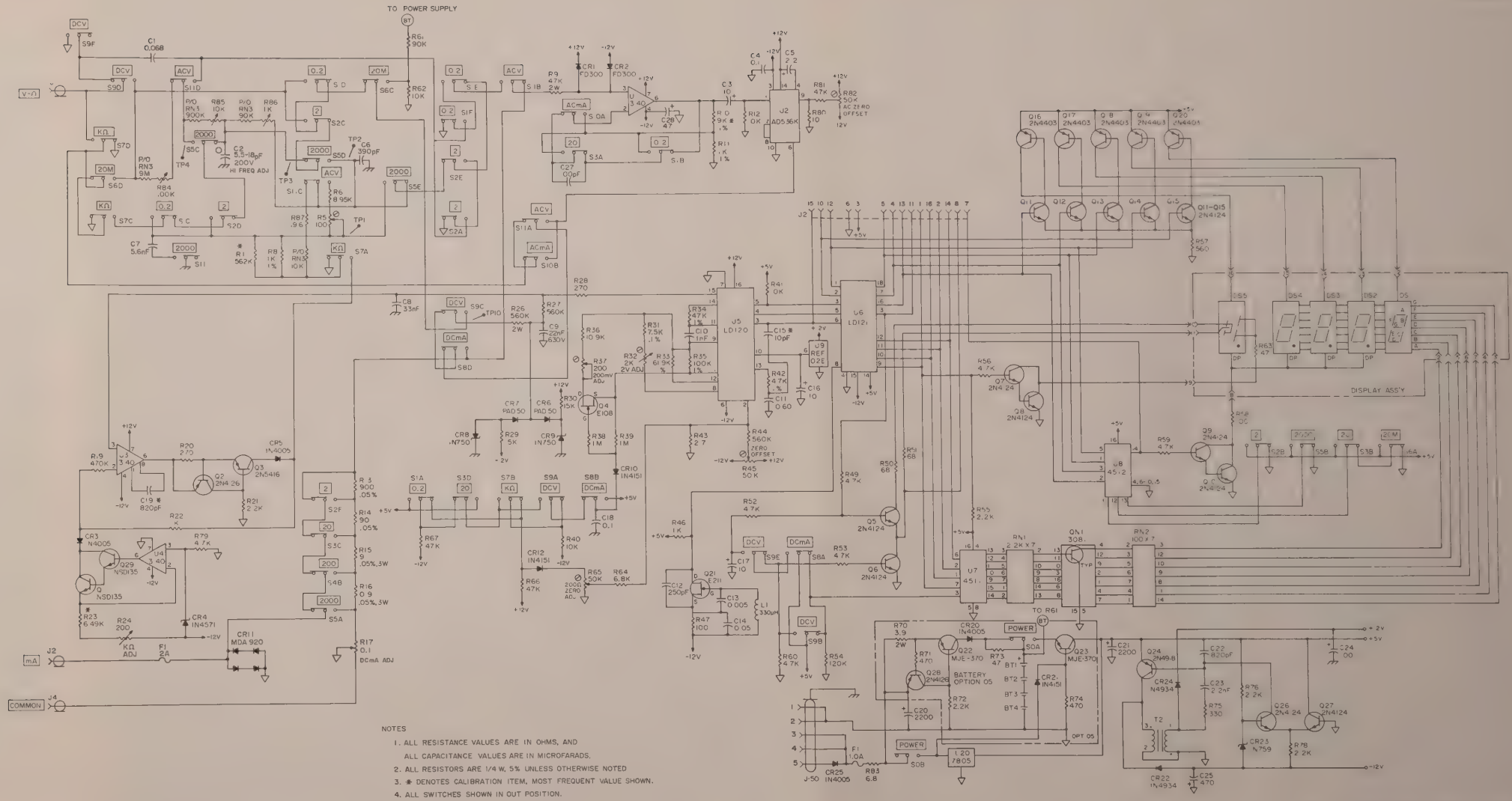

TO POWER SUPPLY
DISPLAY ASS'Y
BATTERY OPTION 05
NOTES
1. ALL RESISTANCE VALUES ARE IN OHMS, AND ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED
3. * DENOTES CALIBRATION ITEM, MOST FREQUENT VALUE SHOWN.
4. ALL SWITCHES SHOWN IN OUT POSITION.

Figure 6–2. Model 3036B, Schematic Diagram

SECTION 7
OPTIONS AND ACCESSORIES

7–1. INTRODUCTION.

7–2. This section contains information for the options and accessories which can be used with the Model 3036A/B Digital Multimeter. Each option and accessory is described individually. Where applicable, field installation procedures, operating and maintenance instructions, a replaceable parts list, and a schematic diagram are included.

7–3. PARALLEL BCD PRINTER OUTPUT, OPTION 01.

7–4. General. The BCD output provides digital measurement information in parallel BCD format to a rear-panel connector for use with digital printers, systems, limit controllers, and other remote applications.

7–5. Specifications.

Type: Serial to parallel converter.

Logic: Positive true.

Form: Four-line BCD 1-2-4-8.
CMOS derived, TTL compatible.
Fan-out of two.
"1"=+3.5 V dc to 5.7 V dc.
"0"=0 to 0.4 V dc.

Continuous Data Output Update Command: By holding "0" state, the BCD output is updated at an internal trigger rate of typically four per second.

Busy Flag (Printer Inhibit): "0" state at Busy Flag output signifies BCD output in process of updating. During this interval, all Data Update commands from printer are ignored. "1" state signifies not Busy. Busy Flag internally modifiable to Ready.

7–6. Operation.

7–7. *Input/Output Data.* The input/output data available at the rear-panel connector J2 is listed in Table 7–1. The pin assignments and the logic level requirements are also listed.

7–8. *Data Update Input.* The Continuous Update command at pin 22, when held at "1" state, will cause the BCD output to be updated at the DMM's display refresh rate of approximately three-four times per second.

7–9. *Busy Flag Output.* The time period of actual updating of the BCD output at pin 2 of the BCD output connector, J2. During this period all external update pulses are locked out and therefore ignored. A signal LOW shows not Busy. This feature operates as the conventional "print" command. A simple modification on the BCD output printed circuit board assembly permits the Busy Flag logic to be inverted and thereby used as a Ready Flag. A signal HIGH on pin 2 will then show that the BCD output is ready for update. A signal LOW indicates not Ready since the serial-to-parallel converter is being updated by the counter. To modify the Busy Flag, proceed as follows:

1. Disconnect the power cord.
2. Remove the top cover of the instrument case. Refer to paragraph 5–33.
3. Locate S 1 (a solder link switch near U5 on the BCD output assembly).
4. Refer to the BCD schematic, Figure 7–1, and remove solder link – "A".
5. Install solder link – "B" to provide a Ready Flag.
6. Replace the top cover and reconnect the power cord.

7–10. *BCD Output Cable.* One-meter long BCD output cable with mating card edge connectors (Ballantine Model) is available as an option. The cable is a 26 wire flat ribbon cable. It is unterminated so that the user may wire his own connector.

7–11. Theory of Operation. The BCD printer output option is a serial to parallel converter with associated control circuitry. It processes the serial output data from U-6 in the 3036A/B into parallel BCD format. Five type D flip-flops in U1, U2, U3, U4 and U5 are the storage registers which convert digit strobes D5, D4, D3, D2 and D1, sequent strobes B0, B1, B2 and B3 and the polarity sign data.

7–12. Update may be continuous at the sampling rate of the 3036A or inhibited by high level at the data update line pin 22, J2. Low level at the input of U6A pin 2 will enable the M/Z pulses. At the end of the zero interval the M/Z line will go high which will preset U5A and send a print command on pin 2, J2.

7–13. "D" Flip-flops U1, U2, U3, U4 and U5 are strobed with the digits strobes in sequence shown in Figure 7–1. The "d" flip-flops are being controlled by U5B. D5 pulse enables the data input into the flip-flops and D1 pulse disables it. U1 through U5 provide buffered outputs to drive 2 Low Power TTL or CMOS.

7–14. At time D5, which is the most significant digit, a high level on B1 will indicate over range.

7–15. Polarity will be indicated at D5 strobe time.

7–16. INTERNAL RECHARGEABLE BATTERY, OPTION 05.

7–17. General. Option 05 equips the Model 3036A/B with four rechargeable nickel-cadmium batteries, installed as shown in Figure 7–2, which can be used in place of ac power to operate the instrument. The optional battery connections and the charger circuit are shown in Figure 6–1. The batteries are recharged by setting the POWER switch S1 to OFF and connecting the ac power to the instrument.

7–18. Specifications.

Continuous Operation: 5 hours (20°C to 30°C)

Charge Time: 16 hours (15°C to 35°C)

Battery Life: 350 to 500 charge-discharge cycles

Battery Type: Four NiCad "C" cells

7–19. Operation. When the batteries are fully charged, the Model 3036A/B may be disconnected from the ac power line and operated for more than 5 hours. The battery-charge condition may be checked by disconnecting the ac power and pushing in the POWER (S1), V (S3), 2000k (S11), and 20M (S12) pushbuttons. A display reading greater than 500 indicates that the batteries are charged. Fully charged batteries will indicate above 535.

Note

It is recommended that NiCad batteries be recharged at least every 90 days and that they be stored where the temperature is below +30°C (+86°F).

7–20. Installation. Battery Option 05 is easily installed in the field. Remove the covers of the instrument (refer to paragraph 5–33). Attach and secure the battery holder and the mounting plate to the underside of the top cover with the screws supplied; install the terminal lug under the right screw. Solder the blue lead to the terminal lug and to the instrument ground. Solder the battery red lead to the + terminal and the black lead to the – terminal, located at the rear left corner of the main printed wiring assembly.

Install and solder lamp DS900 and resistor R900 in the holes provided in the printed wiring assembly (just to the left of the + and – terminals). Replace F50 with a 1/8-ampere, slow-blow fuse.

7–21. With the ac power cord connected, but with the POWER switch OFF, allow the batteries to charge for 16 hours. Note that DS900 lights. After the batteries are charged, check the battery-power operation of the instrument. Check the battery charge as instructed in paragraph 7–19. Replace the top and bottom covers.

7–22. Battery Replacement. Remove the top cover of the instrument (refer to paragraph 5–33). Remove the old batteries. Note the polarity markings in the holder and install four new batteries (Battery Kit P/N 89-10422-1A). Check the battery charge as described in paragraph 7–19 and recharge if necessary. Check the charging mode by noting that DS900 lights. Replace cover and attaching hardware.

TABLE 7–2. PARTS LIST, INTERNAL RECHARGEABLE BATTERY, OPTION 05

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
BT 1	85-10059-0A	BNC C NICK-CAD 1.5 AH	09823	GOULD
BT 2	85-10059-0A	BNC C NICK-CAD 1.5 AH	09823	GOULD
BT 3	85-10059-0A	BNC C NICK-CAD 1.5 AH	09823	GOULD
BT 4	85-10059-0A	BNC C NICK-CAD 1.5 AH	09823	GOULD
CR 20	05-09481-0A	DGP IN4005 600 1A	04713	MOT SI D041
CR 21	05-10026-0A	DGP IN4151 75 50M	24446	GE SI D035 4 2
Q 20	10-10134-0A	TRQ 2N4124 NPN 1 25 PTO-92	4713	MOT 1 300M 50
Q 23	10-10134-0A	TRQ MJE 370 PNP 1 30 P77-03	4713	MOT 25 40
Q 26	10-10035-0A	TRQ 2N4126 PNP 25 PTO-92	4713	MOT 1 50M 60
R 61	12-13157-0A	RFF 90.0K 500.0 MW B	16299	CGW RN60E 25 PPM
R 62	12-13130-0A	RFF 10.0K 500.0 MW B	16299	CGW RN60E 25 PPM
R 70	12-01265-0A	RFC 3.9 1.0W K+-10%	1121	A-B TYP GB
R 71	12-08018-0A	RFC 470.0 250.0MW J+-5%	1121	A-B TYP CB
R 72	12-08023-0A	RFC 2.2K 250.0MW J+-5%	1121	A-B TYP CB
R 73	12-08019-0A	RFC 47.0 250.0MW J+-5%	1121	A-B TYP CB
R 74	12-08018-0A	RFC 470.0 250.0MW J+-5%	1121	A-B TYP CB
R 75	12-01242-0A	RFC 330.0 250.0MW K+-10%	1121	A-B TYP CB
R 76	12-08023-0A	RFC 2.2 K 250.0MW J+- 5%	1121	A-B TYP CB
R 78	12-08023-0A	RFC 2.2 K 250.0MW J+- 5%	1121	A-B TYP CB

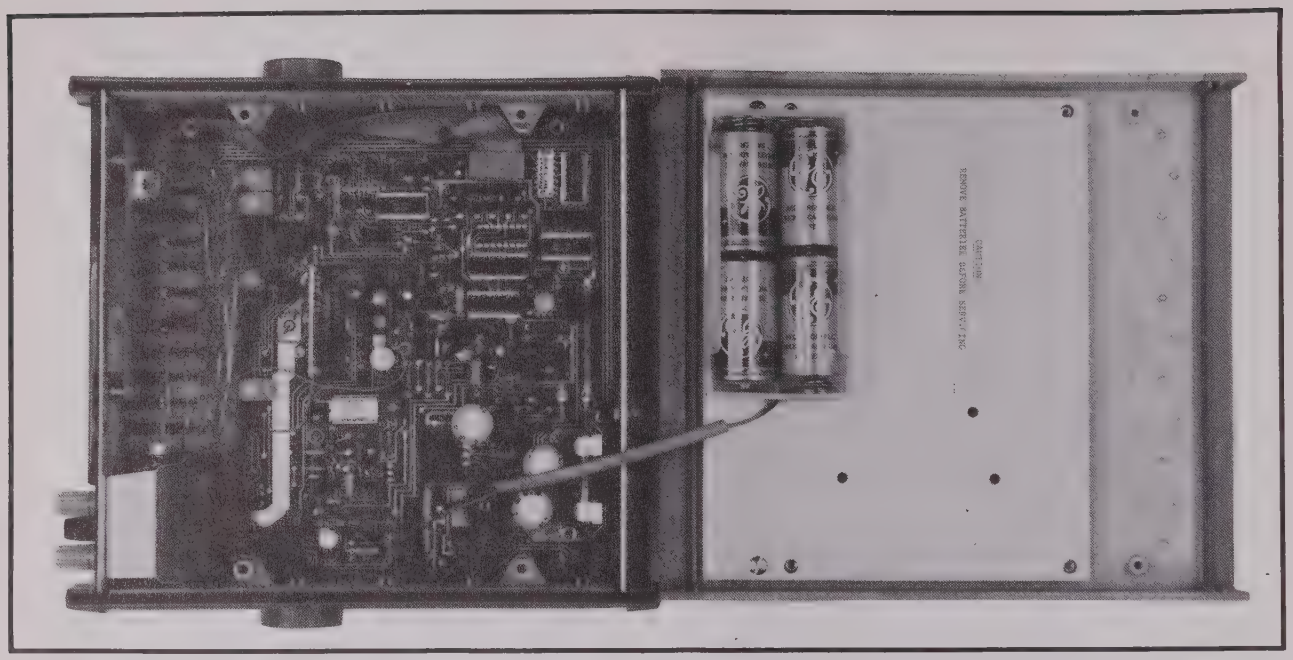


Figure 7–2. Battery Option 05 Installed.

7–23. 20-AMPERE CURRENT RANGE, OPTION 21.

7–24. General. The 20-ampere current range option extends the current measuring capability of the 3036A/B to 20 amperes for both ac and dc rms current. Continuous measurements may be made to 10 amperes. Currents to 15 amperes are limited to 1½ minutes and a duty cycle of 50%. Currents to 20 amperes are limited to 1 minute and a duty cycle of 25%. The standard performance characteristics and specifications of the 3036A/B are not altered with Option 21 installed.

7–25. DC Specifications.

Ranges: ±20.00 amperes
1.5-minute operation to ±15 amperes
1-minute operation to ±20 amperes

Accuracy (15° to 35°C): ±(0.5% of reading + 1 LSD)

Voltage Burden: 0.5 V maximum to 10 A

Maximum Input: ±20 amperes

Operating Time: Continuous to ±10 amperes
1.5 minutes to ±15 amperes (50% duty cycle)
1 minute to ±20 amperes (25% duty cycle)

Response Time: 500 ms

7–26. AC Specifications.

Ranges: 20 amperes
1.5-minute operation to 15 amperes
1-minute operation to 20 amperes

Accuracy (+15°C to +35°C):
15 Hz to 10 kHz (sine wave) ±(2% of reading + 3 LSD)
45 Hz to 3 Khz (sine wave) ±(1% of reading + 2 LSD)
For distorted waveforms having less than 10% total harmonic distortion with no single harmonic greater than 5%, add ±(1.5% + 2 LSD) to the sine wave accuracy specified.

Voltage Burden: 0.5 V to 10 A for sine waves

Maximum Input: 20 A

Operating Time: Continuous to 10 A
1.5 minutes to 15 A (50% duty cycle)
1 minute to 20 A (25% duty cycle)

Response Time: 3 seconds maximum

7–27. Operation.

a. Push the DMM pushbutton switches S1 to ON, S2 to AC or DC as required, S4 to A, and S9 to 20m.

b. Connect the input current leads to tight-fitting, clean, banana plugs which are connected to the 20-ampere range banana jacks on the front panel. Observe polarity for dc current measurements by connecting negative lead to LO connector. Always use the LO connector for the LO side of ac current inputs.

CAUTION

Do not exceed 20 amperes and the duty factors specified. Always set all switches before connecting signal to the 20-ampere input.

7–28. Theory of Operation. A schematic diagram of the 20-ampere current range option is shown in Figure 7–3. A 0.01-ohm resistor is inserted into the low-end sensing return of the 0.1-ohm shunt resistor of RN200. The 0.01-ohm resistor is also a four-terminal network and is connected directly to its own input connector to avoid additional range switching. Proper positioning of the decimal point is performed by depressing the 20m range pushbutton S9.

7–29. Replaceable Parts.

R1200	Resistor, 0.01 ohm, four-terminal	P/N 12129551
—	Window	P/N 47100341

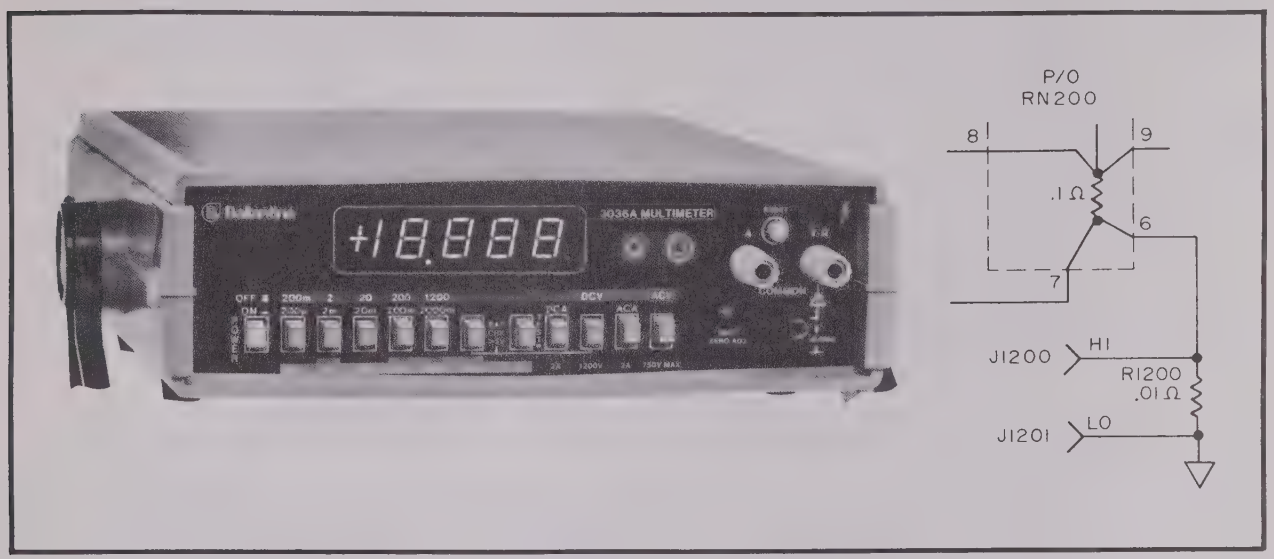


Figure 7–3. Option 21, Front Panel and Schematic Diagram

7–30. DC HIGH VOLTAGE PROBE MODEL 10800B.

7–31. General. The Ballantine Model 10800B DC High Voltage Probe, shown in Figure 7–4 is used to provide the instrument with a dc voltage capability to ±40,000 volts. The probe has a division ratio of 1000:1 and features a ±5% adjustment range for precise calibration at any voltage input.

7–32. Specifications.

Voltage Range: ±1 kV to ±40 kV

Input Resistance: 1000 megohms

Division Ratio: 1000:1

Accuracy: ±1% referenced to calibration point
Voltage Coefficient:
2 ppm per volt, 1 to 10 kV (2%)
3 ppm per volt, 10 to 20 kV (3%)
5 ppm per volt, 20 to 40 kV (4%)

Maximum Input: ±40 kV peak

7–33. Operating Precautions. Before using the 10800B probe, connect a 3.3 MΩ, 1/2 W resistor (P/N 12129340A) from the neutral terminal of J50, the ac power receptacle, to earth ground, and a 47 MΩ, 1 W resistor (P/N 12129350A) from the instrument COMMON to earth ground. These resistors will minimize shock hazard and equipment damage should the probe ground lead be disconnected accidentally. Also, with this modification, the dc common mode rejection will decrease to 90 dB.

WARNING

BEFORE CONNECTING THE HV PROBE, CONNECT THE GROUND-LEAD CLIP OF THE PROBE SECURELY TO THE GROUND (LO) OF THE CIRCUIT UNDER TEST. FAILURE TO OBSERVE THIS PRECAUTION WILL APPLY FULL HIGH VOLTAGE TO THE INSTRUMENT WHICH MAY CAUSE PERSONNEL SHOCK AND INSTRUMENT DAMAGE. THE GROUND-LEAD VOLTAGE MUST NOT EXCEED ±1200 VOLTS PEAK TO THE POWERLINE EARTH GROUND. HANDLE THE PROBE ONLY AT ITS BLACK HANDLE AND AVOID CONTACT WITH THE FLASH GUARD AND TIP AREA.

7–34. Operating Procedure.

a. Push the DMM pushbutton switches S1 to ON, S2 to DC, and S3 to V.

b. Select the DMM 2 range for operation to ±2 kV, the 20 range for operation to ±20 kV, or the 200 range for operation up to ±40 kV. The display will read directly in kV.

c. Plug the termination of the 10800B probe into the V–Ω and COMMON connectors of the instrument, making sure that the red-marked banana plug of the termination mates with the V–Ω connector of the instrument.

d. Connect the ground-lead clip of the probe to the ground (LO) of the circuit under test.

e. Connect the probe tip to the circuit under test.

f. Turn the equipment on to apply the signal and read the instrument display.

7–35. Calibration.

a. Push the DMM pushbutton switches S1 to ON, S2 to DC, S3 to V, and S8 to 2.

b. Plug the 10800B probe termination into the V–Ω and COMMON connectors of the instrument, making sure that the red-marked banana plug of the termination mates with the V–Ω connector of the instrument.

c. Remove the four screws from the cover of the probe termination box and remove the cover to gain access to the potentiometer, R2.

d. Connect the ground-lead clip of the probe to the ground of a Fluke Model 332B DC Voltage Standard.

e. Connect the probe tip to the HI output of the Model 332B.

f. Apply ±1000.00 volts.

g. Use an insulated screwdriver and adjust R2 for a DMM display of .999 to 1001.

Note

Calibration may be performed at any voltage to 40 kV using other voltage standards and DMM ranges.

h. Replace the cover of the probe termination box and secure it with the four screws.

7–36. Schematic Diagram. A schematic diagram of the Model 10800B DC High Voltage Probe is shown in Figure 7–5.

TABLE 7–3. PARTS LIST, DC HIGH VOLTAGE PROBE MODEL 10800B

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R 1	09101640A	RVF 500.0 K 250 MW K CERMET	73138	HELIPOT 72XW VERT MT
R 2	12125950A	RFF 976.0 K 500 MW F+-1%	16299	CGW RN60D9763F
---	55100570A	PROBE BODY AND RESISTOR ASSY	50423	
---	79071410A	CBL 20-1 CONDUCTOR PLASTIC	92194	ALPHA NO. 1706
---	79045230A	WIRE, TEST LEAD, BLK	50423	
---	49044360A	ALLIGATOR CLIP	76545	MUELLER NO. 60

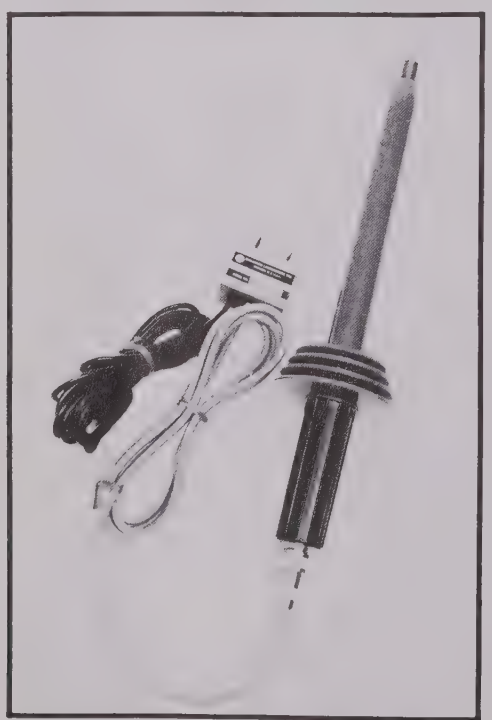


Figure 7–4. Model 10800B DC High Voltage Probe

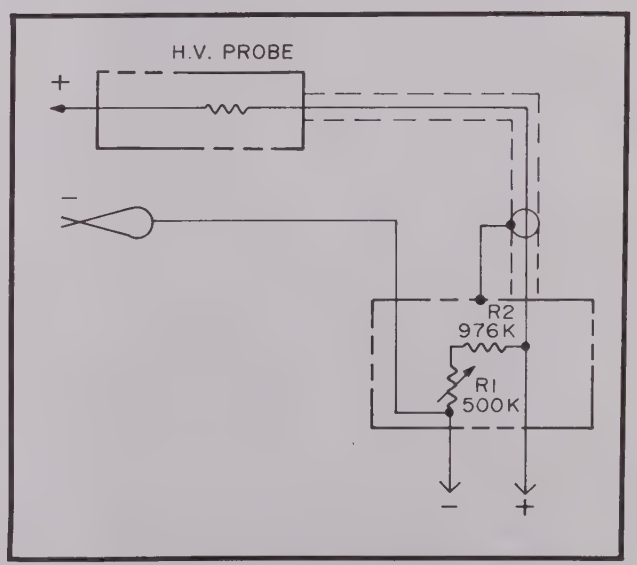


Figure 7–5. Model 10800B DC High Voltage Probe, Schematic Diagram

7–37. AC HIGH VOLTAGE PROBE MODEL 1301B.

7–38. General. The Ballantine Model 1301B AC High Voltage Probe, shown in Figure 7–13, is used to extend the ac rms voltage range of the instrument to 10 kV rms (14 kV peak). The probe has a capacitive division ratio of 10,000:1 (80 dB) and features a ±5% adjustment range for precise calibration at any voltage amplitude and frequency input. The 1301B is not a detector probe and therefore retains the rms response of the 3036A/B. Although the probe is usable beyond 6 MHz, its usefulness with the 3036A/B is limited to the specifications of the 3036A/B.

7–39. Specifications (with 3036A/B).

Voltage Range: <1 kV to 10 kV rms (14 kV peak)

Input Impedance: <10 pF in parallel with 1000 megohms

Division Ratio: 10,000:1 (80 dB)

Maximum Input: 10 kV rms sinusoidal; 14 kV peak

Accuracy: Adjustable ±1% to any reference condition within the specification
All accuracies are additive to the accuracies of the 3036A/B
45 Hz to 10 kHz ±1%
40 Hz to 110 kHz ±2%

7–40. Operating Precautions. Before using the 1301B probe, connect a 3.3 MΩ, 1/2 W resistor (P/N 12129340A) from the neutral terminal of J50, the ac power receptacle, to earth ground, and a 47 MΩ, 1 W resistor (P/N 12129350A) from the instrument COMMON to earth ground. These resistors will minimize shock hazard and equipment damage should the probe ground lead be disconnected accidentally. Also, with this modification, the dc common mode rejection will decrease to 90 dB.

WARNING

BEFORE CONNECTING THE HV PROBE, CONNECT THE GROUND-LEAD CLIP OF THE PROBE SECURELY TO THE GROUND (LO) OF THE CIRCUIT UNDER TEST. FAILURE TO OBSERVE THIS PRECAUTION WILL APPLY FULL HIGH VOLTAGE TO THE INSTRUMENT WHICH MAY CAUSE PERSONNEL SHOCK AND INSTRUMENT DAMAGE. THE GROUND-LEAD VOLTAGE MUST NOT EXCEED ±1200 VOLTS PEAK TO THE POWERLINE EARTH GROUND. HANDLE THE PROBE ONLY AT ITS BLACK HANDLE AND AVOID CONTACT WITH THE FLASH GUARD AND TIP AREA.

7–41. Operating Procedure.

a. Push the DMM pushbutton switches S1 to ON, S2 to AC, and S3 to V.

b. Select the DMM 200 mV range for operation to 2 kV and the 2 range for operation up to 10 kV. The display will read directly in kV.

c. Plug the termination of the 1301B probe into the V–Ω and COMMON connectors of the instrument, making sure that the red-marked banana plug of the termination mates with the V–Ω connector of the instrument.

d. Connect the ground-lead clip of the probe to the ground (LO) of the circuit under test.

e. Connect the probe tip to the circuit under test.

f. Turn the equipment on to apply the signal and read the instrument display.

7–42. Calibration.

a. Push the DMM pushbutton switches S1 to ON, S2 to AC, S3 to V, and S7 to 200 mV.

b. Plug the 1301B probe termination into the V–Ω and COMMON connectors of the instrument, making sure that the red-marked banana plug of the termination mates with the V–Ω connector of the instrument.

c. Unscrew the tip of the 1301B probe to provide access to the calibration adjustment screw.

d. Connect the ground-lead clip of the probe to the ground of an ac voltage calibrator.

e. Connect the probe tip to the ac calibrator and apply 1 kV at 1 kHz.

f. Adjust the probe calibration screw with an insulated screwdriver until the DMM display reads .997 to 1.003.

g. Reinstall the probe tip and recheck the calibration.

7–43. Schematic Diagram. A schematic diagram of the Model 1301B AC High Voltage Probe is shown in Figure 7–7.

TABLE 7–4. PARTS LIST, AC HIGH VOLTAGE PROBE MODEL 1301B

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 1	07081060A	CSM 27 NF 100 V J+-5%	92741	GOODALL TYPE 820UB
R 1	12012240A	RFC 2.7 250 MW K+-10%	01121	A-B TYPE CB
R 2	12012240A	RFC 2.7 250 MW K+-10%	01121	A-B TYPE CB
R 3	12012250A	RFC 22.0 M 250 MW K+-10%	01121	A-B TYPE CB
R 4	12012250A	RFC 22.0 M 250 MW K+-10%	01121	A-B TYPE CB
R 5	12012250A	RFC 22.0 M 250 MW K+-10%	01121	A-B TYPE CB
R 6	12012240A	RFC 2.7 250 MW K+-10%	01121	A-B TYPE CB
---	89054691A	GROUND LEAD ASSY	50423	
---	80070000A	SILICONE SEALING COMPND	71984	DOW CORNING NO. 5

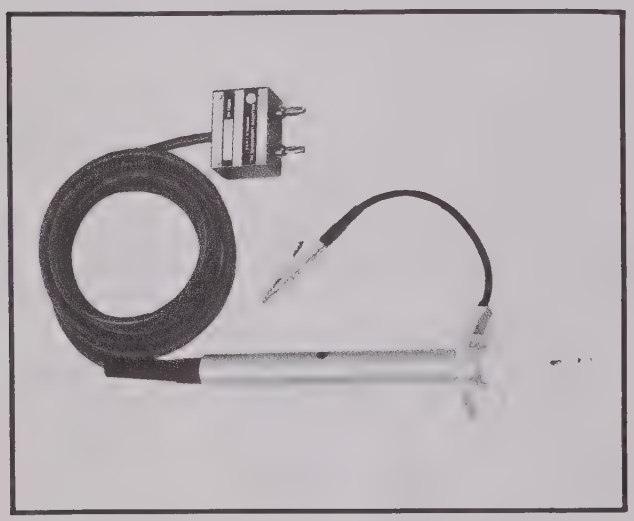


Figure 7–6. Model 1301B AC High Voltage Probe

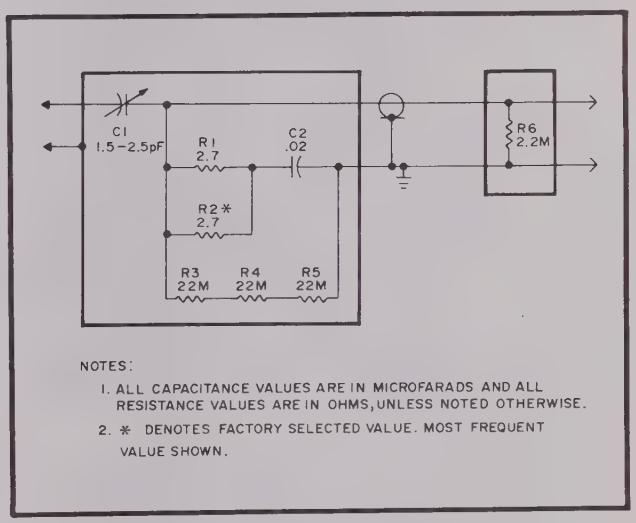


Figure 7–7. Model 1301B AC High Voltage Probe, Schematic Diagram

7–44. RF DETECTOR PROBE MODEL 10850B.

7–45. General. The Ballantine Model 10850B RF Detector Probe, shown in Figure 7–8 is a peak detector probe calibrated in rms voltage. It uses semiconductor diodes and provides measurement capability beyond 700 MHz for sinusoidal signals. The maximum signal is 30 volts peak-to-peak and a blocking capacitor will hold off dc to a maximum of ±200 volts.

7–46. Specifications.

Frequency Range: <50 kHz to >700 MHz

AC to DC Transfer Accuracy (20°C to 30°C): Calibrated to ±1% at any point from 100 kHz to 200 kHz. Response ±0.5 dB from 100 kHz to 200 MHz; ±1 dB to 270 MHz; ±3 dB to 470 MHz

AM Detector: 50 Hz to 20 kHz

Maximum Input Voltage: AC, 30 volts; dc, ±200 volts maximum

Operating Voltage: Usable from 10 mV to 30 V; linear range, 250 mV to 10 V rms

Input Impedance: ≅3 pF shunted by ≅2 MΩ

Response: Peak responding from 250 mV to 30 V

Cable Length: 150 cm (5 ft)

Accessories: Ground lead, 50 Ω BNC adapter sleeve, retractile hook tip

7–47. Operation. The probe is supplied with an integral straight tip. It may be used with its ground lead connection to 100 MHz. Additionally, a retractile hook-tip is provided for convenience. For optimum accuracy above 10 MHz, the coaxial BNC adapter sleeve should be used. No ground lead is required when using the BNC adapter. The adapter is slipped onto the probe barrel and fits into any BNC female connector. The probe should always be used in a terminated system. The Ballantine Model 12630A 50-ohm BNC feed-thru termination is recommended.

Maximum input voltage to the probe is 30 V rms or ±200 V dc. The 30-volt ac level is additive and must be combined with the dc limit so as not to exceed ±200 volts peak.

CAUTION

DC input level changes greater than ±200 volts will damage the probe.

Ballantine Model 12628A 100:1 capacitive attenuator is an accessory for the 10850B RF Probe. Simply plug this attenuator into the probe tip and the maximum input voltage is extended to 300 volts rms. The 12628A is terminated in a female BNC fitting for convenient connection to 50-ohm coaxial and shielded test points.

Take care to avoid ground current and common mode voltage measurement errors. Use battery off-line operation and/or check the effects of earth grounding the COMMON connector of the DMM.

7–48. Voltage Measurement of CW or FM Sine Wave Signals.

a. Connect the 10850A probe termination to the V–Ω and COMMON inputs of the DMM. Make sure the red-marked (HI) banana plug is connected to the V–Ω connector.

b. Attach the required probe tip, BNC adapter, and termination. Connect the probe to the circuit point to be measured.

c. Push the DMM pushbutton switches S1 to ON, S2 to DC, and S3 to V.

d. Select the desired voltage range: 200m, 2, or 20.

e. Note the display, which reads in volts rms.

7–49. Demodulation Measurement of AM Signal On High-frequency Carrier.

a. Connect the 10850A probe termination to the V–Ω and COMMON inputs of the DMM. Make sure the red-marked (HI) banana plug is connected to the V–Ω connector.

b. Attach the required probe tip, BNC adapter, and termination. Connect the probe to the circuit point to be measured.

c. Push the DMM pushbutton switches S1 to ON, S2 to AC, and S3 to V.

d. Select the desired range: 200m, 2, or 20.

e. Make sure the AM frequency is within the range of 50 Hz to 20 kHz and that the amplitude is stable.

f. The digital display will show the rms voltage of the carrier.

7–50. Calibration. The Model 10850A RF Probe is normally calibrated at 100 kHz. An ac voltage calibrator, such as the Hewlett-Packard Model 745, may be used to set the calibration with the trim potentiometer provided in the probe termination box. No high-frequency calibration is required. Proceed as follows:

a. Connect the 10850B probe to the V–Ω and COMMON inputs of the instrument.

b. Remove the four screws and cover from the probe termination.

c. Connect the 10850B probe to an ac voltage calibrator, such as the Hewlett-Packard Model 745. Set the calibrator output to 1 volt rms at 100 kHz.

d. Push the DMM pushbutton switches S1 to ON, S2 to AC, S3 to V, and S8 to 2.

e. Adjust the trim potentiometer with an insulated screwdriver until the instrument display reads .998 to 1.002.

f. If desired, check the probe at 250 mV rms, 10 V rms, and 25 V rms inputs.

g. Replace the probe termination cover and the four screws.

7–51. High-Frequency Certification. Should high-frequency certification be required, use a Ballantine Model 440 Micropotentiometer with a 220-ohm coaxial resistor to drive a General Radio 874-K Line Stretcher and a GR 874 BNC female adapter with a 50-ohm feed-thru termination, Ballantine 12630A. Connect the 10850B BNC adapter sleeve and fit the probe into the female BNC of the 12630A. Then calibrate the micropotentiometer with a 100-kHz signal input. Increase the input ac signal until the probe output is .500 volt as read on the DMM. Monitor the micropotentiometer thermoelement output with a dc millivoltmeter, such as the 3036A/B which has a 200 μV resolution. Then apply an rf signal generator to the micropotentiometer in place of the 100-kHz input. Increase the rf input until the micropotentiometer thermoelement output voltage is identical to that noted with the 100-kHz input. Then slide the GR 874-K Line Stretcher until the average of the maximum and minimum signals are noted on the 3036A/B which reads the 10850B probe output. This reading is the response of the 10850B probe at this frequency referenced to 100 kHz.

7–52. Schematic Diagram. A schematic diagram of the Model 10850B RF Detector Probe is shown in Figure 7–9.

7–53. Parts List. The probe is sealed and the entire probe must be replaced when the demodulator probe head is faulty. Replaceable parts are listed in Table 7–5.

TABLE 7–5. PARTS LIST, RF DETECTOR PROBE MODEL 10850B

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C 1	07025920A	CMB 1.0 NF 1.0 KV K+-10%	84171	ARCO TYPE CCD-102
R 1	12126080A	RFF 1.21 M 500 MW F+-1%	16299	CGW RN65D1214F
R 2	09101200A	RVF 100.0 K 250 MW K CERMET	73138	HELIPOT 72XW VERT MT
---	85100580A	PROBE AND CABLE ASSY	50423	

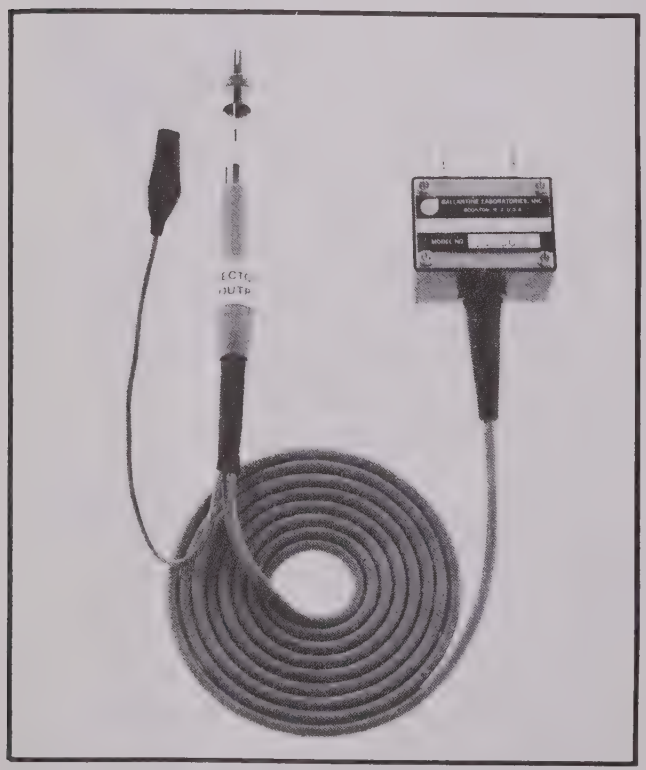


Figure 7–8. Model 10850B RF Detector Probe

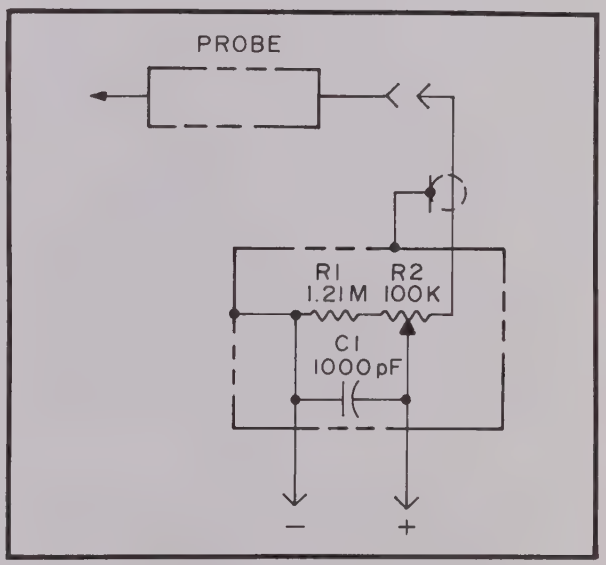


Figure 7–9. Model 10850B RF Detector Probe, Schematic Diagram

7–54. CURRENT PROBE, AC, CLAMP-ON MODEL 10860A.

7–55. GENERAL. The Ballantine Model 10860A AC Current Probe extends the ac current measuring capability of Digital Multimeters. The probe covers a current range from 2 to 600 amperes. Frequency coverage is from less than 50 Hz to greater than 400 Hz. Nominal accuracy is ± 3% at 60 Hz. A voltage limiter is incorporated in the current probe to protect the operator against electric shock and limits the output voltage to 2.4 volts peak to peak irrespective of the test current magnitude or DMM current range selected. The clamp-on feature allows ac currents to be measured without breaking into the leads of the circuit under test. The effect of moving the current conductor from the center to any position within the core jaws is less than 3%.

7–56. SPECIFICATIONS.

Frequency Range: < 50 Hz to > 400 Hz.

Current Range: 2 Amperes to 600 Amperes Sinusoidal Current.

Accuracy:

Entire range with current conductor centered ± 3% of Scale used. Calibrated at 60 Hz.

Frequency Response:

> 25 Amperes, 50 to 400 Hz: ± 3% of Full Scale.

> 15 Amperes, 50 to 400 Hz: ± 4% of Full Scale.

> 10 Amperes, 50 to 400 Hz: ± 10% of Full Scale.

Conductor Position: The effect of moving the current conductor from center to any position within the tightly closed core jaws is < 3%.

Test Conductor Size:

Round Wires Diameter to 38 mm (1.5 inch).

Rectangular and Square Conductors to 38 mm (1.5 inch) cross section.

Foils and Sheets with maximum thickness of 2.8 mm (0.11 inch) and 1.8 inches wide.

Insulation: Insulation of probe housing is designed for operation to 650 volts rms at 600 Hz.

Safety: To protect the operator against shock, an overvoltage limiter on the output connections limits terminal voltage to 2.4 volts peak to peak irrespective of test current or load.

Connector: Dual banana plugs spaced 1.9 mm (0.75 inches).

7–57. OPERATING INSTRUCTIONS.

WARNING

The clamp-on probe housing is made of high quality insulation and designed to provide long service under stress of frequent usage. EXERCISE EXTREME CARE WHEN MEASURING HIGH CURRENTS AND WHEN CLAMPING ON WIRES OR APPLIANCES CARRYING HIGH POWER LINE VOLTAGES.

NEVER USE THE PROBE WHEN THE INSULATING MATERIAL OR THE HOUSING IS DAMAGED OR WHEN THE MAGNETIC CORE MAY COME IN CONTACT WITH HIGH VOLTAGES.

7–58. Use the following procedure for operating the Model 10860A AC Clamp-On Current Probe with the 3028 Series of Digital Multimeters.

a. Plug the 10860A dual banana termination into the A and COMMON terminals of the DMM.

b. Push in the A pushbutton to select the current function.

c. Select ac operation. The 10860A can be used on sinusoidal and distorted ac signals so that the rms responding detectors of the 3028 Series will provide improved accuracy of measurement.

d. Select the DMM Current Range as indicated below.

DMM Range	Measurement Range With 10860A Probe
20 mA	2A to 20A
200 mA	20A to 200A
2000 mA	200A to 600A

e. Clamp the probe around the current carrying conductor to be measured. Center the conductor within the core jaws. Make sure jaws are firmly closed and in full contact.

Note

Clamping the probe around more than one current carrying conductor at a time produces a reading on the DMM which is the vector sum of the currents in each of the conductors.

f. Read the DMM. It is indicating the measured current in Amperes.

7–59. OPTION 30 – Provides an AC Power Adapter for 120V, 60 Hz to 400 Hz.

PART NO. 85100691 Power Adapter, 103V to 127 V AC rms 60 Hz to 400 Hz wall plug mount with 8 foot cable terminated in 5 pin DIN locking connector plug.

7–60. OPTION 31 – Provides an AC Power Adapter for 230V, 50 Hz to 400 Hz.
PART NO. 85100701 Power Adapter 210V to 248V AC rms 50 Hz to 400 Hz benchmount with 2 foot unterminated input cable (for installation of European Mains Plug) and 8 foot output cable terminated in 5 pin DIN locking connector.

7–61. MAINTENANCE

7–62. The Model 10860 A is a rugged instrument designed for long life in every day service. The high quality plastic housing must be checked for damage to avoid electrical contact with the magnetic jaws. Avoid solvents or vapors which may attack the plastic. Clean with water and mild detergents.

7–63. Keep the magnetic surfaces of the jaw mating surfaces clean and free from dust, wire insulation or other dirt. The clamp-on probe functions only with completed mating jaws to hold the magnetic reluctance to a minimum and assure accuracy and repeatability of all current measurements.

7–64. The probe is not field calibratable and depends on the transformer current ratio for accuracy.

7–65. CHECKING THE OVER-VOLTAGE LIMITER.

a. Connect the current probe to the V-Ω and COMMON inputs of the DMM. Set the function for ac voltage on the 2 volt range.

b. Clamp the current probe jaws on a conductor carrying more than 50 amperes.

c. The voltage indicated on the DMM must not exceed 1.9 volts or the four current limiting diodes in the probe termination must be replaced. Use 3 ampere rated 50 volt diodes such as 1N5400 Ballantine P/N 05100630A.

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Ballantine Laboratories, Inc.
P.O. Box 97, Boonton, New Jersey 07005, U.S.A.
Telephone: 201-335-0900, TWX: 710-987-8380